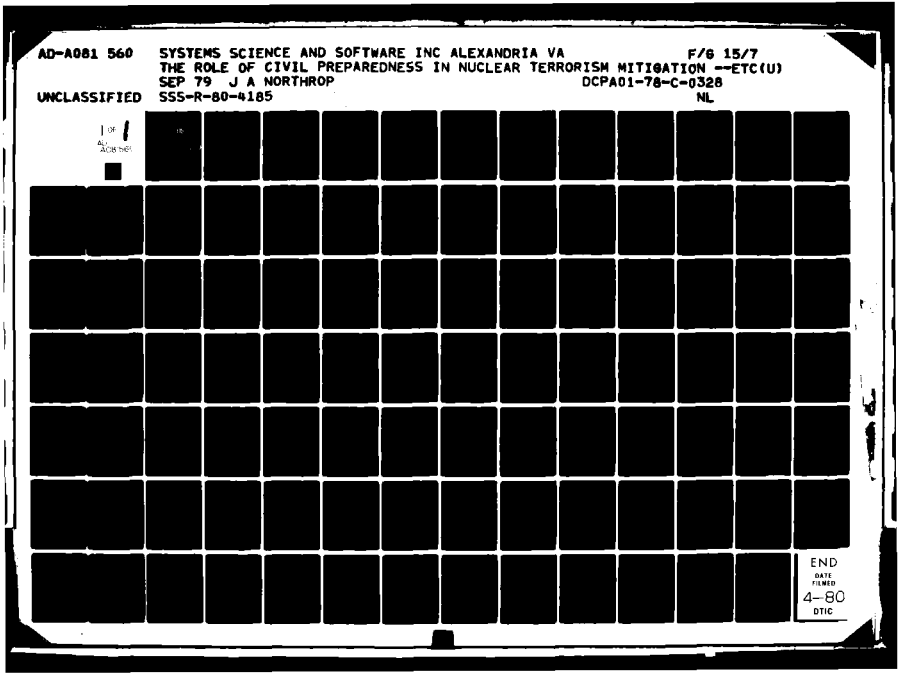
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LEVEL II

The Role of Civil Preparedness in Nuclear Terrorism Mitigation Planning

Final Report

Prepared for
Federal Emergency Management Agency
under Contract DCPA01-78-C-0328
Work Unit 2613D

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

September 1979

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The Role of Civil Preparedness in Nuclear Terrorism Mitigation Planning

by
John A. Northrop

for
Federal Emergency Management Agency
Washington, D. C. 20472
under Contract DCPA01-78-C-0328
Work Unit 2613D
Mr. George Divine, COTR

This report has been reviewed in the Federal Emergency Management Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Federal Emergency Management Agency

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An assessment of the objectives and capabilities of terrorist groups leads to the conclusion that although an explosion of a small nuclear bomb in a city is improbable, planning for an adequate emergency response is necessary. At the Federal level current planning places primary emphasis on management of terrorist events themselves, rather than on subsequent mitigation. The responsible agencies that will be involved must develop working relationships which will allow a rapid and coherent response to the massive damage and casualties that would result. Some state planning has been made, but local authority planning

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is very limited. These plans, and their integration at all levels of government, would be greatly enhanced by the drafting of models which could be adapted to individual state and local requirements.

Preliminary assessments of effects of low-yield nuclear explosions in cities show significant changes, produced by massive building structures, to conventional data. Such data when further developed will provide important guidance to urban nuclear emergency planners. A new methodology is proposed for modeling the economic impact of terrorist attacks tailored to the nationwide incapacitation of unique industrial processes.

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I SUMMARY

The generally increasing level of terrorist violence during the last decade appears to have reached a plateau in the last few years. At the same time this violence, perhaps because it has become more commonplace, appears to be losing some of its coercive power. Thus the stage appears set for a major escalation to nuclear violence, which might be through either the dissemination of radioactive contamination or, more critically, the explosion of a small nuclear device. It is generally accepted that a weapon designed and fabricated by a terrorist group would be a credibile enough threat to demand a serious response planning.

The purpose of this study is to identify the impact that nuclear terrorism will have on civil preparedness policies and planning options, followed by an examination of the effectiveness of current planning in both government and private sectors. This policy and planning study is supported by an evaluation of the physical effects of a small nuclear detonation in a city and our capability to locate a hidden nuclear weapon before it detonates.

A probable target of a terrorist nuclear explosive would be a large urban population, represented by the commercial district of a major city. Coercion could be brought by announcing that a large group of people was hostage to a secreted nuclear explosive having a preset detonation time. There is a response mechanism in the government which places the management of the event with the FBI. The DOE has a specialist team practiced in the location of hidden nuclear weapons and other radioactive material. However, the team's capability to locate a hidden weapon from some distance is limited, with success usually requiring reliable localizing information from the terrorists or other sources.

A preliminary examination was made of the effects of a 1-KT bomb detonated in the center of a street in an area of tall office buildings. The yield represents a reasonable average of previous assessments of probable terrorist professional capability. Since the range of nuclear effects from such a yield is comparable to urban block size, a brief study was made of the modification to these effects by urban structure. Although initial nuclear radiation from a low-yield weapon in an open environment will have a greater lethal range than other effects, the absorption of this radiation by buildings will change this except for those

people on the street directly viewing the detonation. The fireball thermal radiation will be eliminated for the majority of people who are protected by structures, while even those in the street in which the weapon is located will be exposed to a greatly reduced thermal flux. The fallout distribution will tend to be reduced in extent by the reduced heat in the fireball. However, any fallout distribution is so highly sensitive to details of the wind pattern that it would be difficult to capitalize on this reduced distribution.

A numerical blast transmission calculation was made using the 1-KT source propagating in a stylized urban geometry of streets and avenues, with the blocks of buildings having rigid, reflecting walls. In this rough approximation, carried out to 1½ seconds, when the overpressure had decayed to 2.4 psi, it was found that the blast was somewhat canalized down the street in which the weapon was located. However, in other directions there was a general reduction in the distance to which lethal blast levels were propagated. Further calculations using more realistic environmental conditions are required to clarify these effects.

Numerous previous studies of the impact of general nuclear war on the gross national product have generally used input-output analyses at the level of whole industries. It has generally been concluded that the complex interrelationships between the elements of a modern industrial society will result in production losses which are proportionally greater than the loss of individual facilities. This study examines another possible methodology for assessing the impact of terrorist attacks directed against a class of key industrial processes which constitute a critical element in a broad spectrum of essential industries. This methodology is felt to have considerable potential if data become available on the elasticity of substitution of specific process equipment. It will point the way to potential bottleneck processes having wide industrial application which are potentially vulnerable to small nuclear attacks by sophisticated terrorists having the objective of inhibiting national mobilization.

Response planning for nuclear terrorism has, so far, fallen victim to widely diverging perceptions of those who are unconvinced that the threat has significant credibility, those who feel that it can be managed as is currently done with conventional terrorism, and those primarily concerned with mitigation and recovery who consider it to be just one of a

class of serious disasters. At the national level the current focussing of emergency response planning in FEMA will provide the basis for developing an "equal partner" relationship with the present State and Justice Department structure which manages terrorist events. This partnership will provide the executive branch staff support to the President, who is likely to assume direct command of such a serious catastrophy.

Some planning has been started at the state level for the management of nuclear emergencies. However, even the most advanced plan (California) has not won approval from state, Federal, or local authorities, and has shortcomings in resulting jurisdictional conflicts and specifying operational responsibilities. The adoption by each state of a generally similar plan would expedite time-urgent Federal/state interactions in a nuclear emergency crisis.

There has been little planning at the big city level, which is needed to cover policy, jurisdictional, and operational issues. Again, a model plan which gains wide acceptance would streamline interactions between city, state and Federal government structures. Further evaluation of the physics effects of small nuclear weapons in cities is needed to provide input data for detailed city response plans.

A partial set of the more important conclusions and recommendations are:

- Nuclear terrorism of major consequence is a credible and serious threat.
- Policies to manage such events should be developed.
- Event and mitigation management should be integrated.
- Mitigation requirements are generally compatible with the broad range of other emergency response needs.
- Current planning at all levels of government is incomplete.
- Jurisdictional conflicts need to be resolved.
- Both the continuity of our government and our willingness to mobilize will be critically dependent on the public's perception of the governments' response to a prolonged series of nuclear terrorism.

II INTRODUCTION

What, up until the present time, have been quite separate streams of national concern over destructive terrorism on the one hand and emergency preparedness on the other, may now be about to coalesce into a common area of mitigation planning for the consequences of nuclear terrorism. The intention of this study has been to make a very broad overview of the potential for such terrorist acts, the consequences of them should they occur, the status of our policies and plans to cope with them, and their compatibility with the broader range of emergency planning of which they must be a part. The objectives of this study, the current "state-of-the-art" of past research and planning that might contribute to reaching these objectives, and the methodology used in the present study will be presented in the following paragraphs.

Objectives

The objectives of this work fall generally into two broad categories: a technical evaluation of the physical phenomenology of small nuclear weapons when hidden and detonated in a city, and questions of policy and planning for response to such a potential threat. They are specified in the following tasks:

- Define the concept of terrorism and identify the impact on civil preparedness policies and options.

  The concept of terrorism would include an examination of the objectives of terrorist groups, their capabilities and limitations, their probable technical expertise, and their likely targets. Neither policies which have been developed for managing terrorist events on the one hand, or civil defense in the case of strategic nuclear war on the other, may be appropriate.

- Describe the physics of small nuclear weapon effects in confined civil areas.

  Since general weapon phenomenology is a quite mature science, the objective is to identify significant deviations from the commonly accepted handbook data of importance to emergency planners.

- Define the Federal civil preparedness emergency response to the organizational aspects of small nuclear bomb disposal.

  This task requires an assessment of the current capability to locate, identify, deactivate and remove a terrorist nuclear weapon, as well as the jurisdictional and operational interrelationships of the agencies involved.

- Determine the effectiveness of current and proposed policy, legislation and planning options of Federal agencies, industry and other non-government areas and suggest methods to optimize compatibility with civil preparedness alternative planning.

  Planning for response to nuclear terrorism by government agencies must accept that it will be only a small part of the much broader problem of emergency preparedness planning and as such must conform to general agency responsibilities. In preparedness planning in non-government areas the dominant importance of economic factors, as well as the current regulatory climate, must be accomodated.

Background and State-of-the-Art

Civil emergency preparedness has been motivated by two rather independent concerns: survival in the case of a strategic nuclear conflict and mitigation planning for a broad range of natural disasters and lesser civil emergencies. Classic civil defense has been on the sidelines of national concern ever since the relaxation of tensions following the Cuban missile crisis, consistent with our stated policy of deterrence through mutual assured destruction. Increased concern over the strategic balance, coupled with an apparent strong and growing Soviet civil defense program, led in October, 1978 to Presidential Decision 41 linking these two factors in U.S. defense policy. The issues involved are still under active consideration, as can be seen for example in the recent Senate debate on SALT-II.

In parallel with this evolution in classic civil defense, there has been increasing concern over mitigation planning for both natural and man-caused disasters. In recent months these have ranged from chlorine tank car derailments to the Three Mile Island reactor accident in Harrisburg, Pennsylvania, with potential disasters such as the anticipated California earthquake frequently brought to public attention. Continuing public concern over environmental contamination, not always associated with time-urgent crises requiring emergency planning, nevertheless offers added impetus. The Sevaso, Italy dioxin release required the emergency evacuation of a large threatened population, while the Love Canal chemical contamination in Buffalo, New York appears serious enough to have so far required the dislocation of over a hundred families.

These evolving concerns in emergency preparedness culminated in June 1978 in the President's decision[1] to create the Federal Emergency Management Agency (FEMA) through a consolidation of other existing Federal

organizations having emergency management and assistance functions. His forwarding letter to the Congress sets the principles for national emergency preparedness.

- "This reorganization rests on several fundamental principles. First, Federal authorities to anticipate, prepare for, and respond to major civil emergencies should be supervised by one official responsible to the President and given attention by other officials at the highest levels.
- Second, an effective civil defense system requires the most efficient use of all available emergency resources.
- Third, whenever possible, emergency responsibilities should be extensions of the regular missions of Federal agencies.
- Fourth, Federal hazard mitigation activities should be closely linked with emergency preparedness and response functions."

The current state-of-the-art in the location of hidden nuclear weapons or their special nuclear materials has evolved through a series of nuclear weapon accidents over many years. Highly sensitive search instrumentation has been developed, and teams specially trained in their use stand ready on two-hours notice for deployment to the field. But in spite of these sophisticated efforts, search for a hidden weapon is currently limited to a distance of tens to several hundred feet at a maximum. Certain types of urban environments would even further restrict this range. The technical details of the NEST capabilities will be further developed in a later section. However, it should be noted that there is little technical reason to anticipate a rapid improvement in current capabilities, which require either luck or good terrorist information for a hidden weapon to be located. The organizational aspects of such searches have been highly developed in a series of interdepartmental memoranda, and are frequently exercised through a continuing series of both real incidents and planned exercises.

The state-of-the-art of small nuclear weapon phenomenology is highly developed for yields down to 0.1 KT for bursts either in the air, on the surface of the ground, or underground. Intermediate cases such as when the weapon detonates in the air but with the fireball partially touching the ground, or for a partially buried weapon in which the explosion bursts through the surface, are less well defined. But in all of these cases the surface is considered a smooth, flat surface over which the effects propagate to a specific target (person or structure). Such approximations are valid when the range of effects is large compared to the surface roughness,

which for low yields and large urban structures is not a good assumption. The mathematical calculational techniques are available to obtain good urban data. However, the calculations are expressive and are unique to the details of each urban geometry. Techniques are required to develop data for broad classes of urban environments, such that a limited number of detailed calculations will provide an adequate basis for emergency response planning.

The impact of nuclear war in creating physical damage to industry has been studied in great detail since Nagasaki in World War II. At the same time it has long been recognized that the total effect on the economy will be far more than the sum of individual industrial damage. The interdependence of different industries producing primary, intermediate, and final products through an interconnecting web of transport and other support industries will have a multiplicative effect on any damage. The classic Leontief methodology examines this interrelationship between industries through the use of input/output data, and is limited by the very complexity of industrial interconnections. In addition, this technique has limited applicability to the present case of nuclear terrorism in which broad and rather indiscrimate damage will be replaced by limited key highly selected attacks.

The state-of-the-art in planning the national response to the threat of terrorism has focused on its political and criminal aspects. The early frequency of aircraft hijackings, along with the attendant issue of Foreign sanctuaries for political victims, placed the Department of State in the forefront of U.N. discussions on a treaty. Domestic terrorism, recognized as any of a large variety of criminal acts, although having a broader political motivation, naturally fell within the normal jurisdiction of the Department of Justice. But whether terrorism was a domestic issue or had international aspects, national policy has so far emphasized prevention, management of hostage negotiations, and criminal investigation, apprehension, and conviction. It is implicit in this management structure that the consequences of a terrorist event will not exceed routinely available emergency facilities.

At the Federal level there are two lead agencies for terrorism. The Department of Justice has jurisdiction within the U.S., while the State Department has the lead in terrorist events taking place outside the U.S. but in which significant U.S. interests are involved. The current

organizational structure starts with the Special Coordinating Committee of the National Security Council, which provides guidance to the Executive Committee to Combat Terrorism (ECCT), which in turn is supported by the Working Group to Combat Terrorism (WGCT). The ECCT, chaired by a representative of the State Department and having a representative of the Department of Justice as deputy chairman, might thus be considered to be the focal point not only for planning but also for operational response. The WGCT, with a membership of representatives from some 27 Federal departments and agencies, is thought to be the forum for coordinating the response to terrorism.

In practice, during the act of duration of a terrorist event, when negotiations seeking release of hostages are of primary importance, Justice is the lead agency, using the FBI for operations in the field. In the case of nuclear terrorism, when it is clear that DOE and DOD will necessarily have a major involvement, the interrelationship of the three groups has been quite well defined through a series of Memoranda of Understanding (MOUs). However, other attempts to reach firm policy and procedural agreements amongst responsible Federal agencies has not been achieved despite several attempts, primarily by F.P.A., in recent years. This lack of overall preparedness for a coherent action by Federal agencies is evident particularly in the area of emergency response planning. Should terrorists now turn to nuclear weapons having the potential of causing tens of thousands of casualties, FEMA must be prepared to take the lead in mitigation planning.

The state-of-the-art of planning at state level varies considerably from state to state but is generally quite limited. A recent series of studies by the National Governors' Association has primarily focused attention on Comprehensive Emergency Management to cover a broad spectrum of man-made and natural disasters. A part of this study was devoted to terrorism, with emphasis on legalistic and Federal agency responsibility aspects. Several states have initiated nuclear emergency management plans, with the California plan the most advanced, although even it appears not to have received broad state or Federal acceptance. Nevertheless, it has been applied to several nuclear emergencies in that state, with rather mixed results. The application and limitations of this plan will be discussed in a later section.

There appears to be little local planning which is applicable specifically to nuclear terrorism. This deficiency is most apparent when it is recognized that the health and safety is, in the first instance, the direct responsibility of mayors or their equivalent in other communities. Lack of such planning will exacerbate jurisdictional confusion with state and Federal authorities were an event having serious consequences to take place today. The urban weapon phenomenology studies discussed above will make a significant contribution to such city planning.

Thus, current emphasis at both national and state levels is the consolidation of all forms of emergency planning. The potential for highly destructive terrorism presents an added dimension to this general discussion. Current national policy towards terrorism reflects its international geopolitical origins, which have been followed by several stages of increasing destructiveness to people and property. In the 1960's terrorist acts generally involved only a few people, were frequently symbolic in form, and caused no deaths and little property damage. Starting in the early 1970's there was a major escalation in the level of violence, typified by the Lod Airport (Israel) and Munich Olympic events. In the later 1970's the numbers of people continued to increase with a corresponding potential for more severe consequences. The South Moluccans' taking hostage in Holland both a train and a school involving over a dozen terrorists and a hundred hostages is representative of this period. Although a continuation of this trend towards constantly greater violence is not assured, the probability that terrorists might turn to nuclear (or even chemical or biological) weapons of mass destruction is thought by many to warrant serious thought.

Methodology

The several disciplines involved in this study (governmental policy and plans, economics, and physics) have demanded an equally broad selection of methodologies.

The primary task in evaluating governmental policy and planning for the management of the consequences of serious nuclear terrorism has been to pull together many small pieces from many agencies, each piece generally developed for some other reason than nuclear terrorism, and evaluate their probable integrated performance for this case. Several data sources have been used.

- Many agencies have provided policy and planning documents, many of which remain in essentially draft form, as they have not received government wide acceptance. Concurrence has been much more frequent in bilateral MOU's, which have been used by several agencies in managing nuclear terrorist incidents.
- Interviews with responsible officials and other experts in specific fields have been extremely helpful in exposing problems and revealing future planning not yet ready for documentation.
- A careful examination of specific case histories of certain incidents have revealed insight into the probable unfolding of a relevant terrorist event management.

In evaluating the weapon effects phenomenology in a city, a combination of a semi-quantitative general survey and a detailed blast calculation have been used.

- Thermal burn, fallout, and initial nuclear radiation handbook data for 1-KT surface bursts were examined for modification by urban buildings. Primary emphasis has been to place limits on these modifications to determine whether the deviations are significant to emergency planners. Any significant uncertainties exposed would require more detailed, explicit calculations.
- Since blast effects are known to be the primary cause of death in such an environment, a preliminary two-dimensional wedge numerical calentation was made in a stylized urban geometry having blocks of rigid, reflecting building walls. A further development of this work would allow greater realism in building shapes and energy loss mechanisms. Calculational tools also exist for looking at the influence of the local geometry around the weapon location, although this work has not been included in the scope of the study.

The study of the economic, industrial, and mobilization impact of serious nuclear terrorism has had two elements in its methodology.

- Previous attempts to make detailed studies of the vulnerability to terrorism of specific industries have frequently floundered from lack of cooperation by the industry and/or its corresponding Federal agency. Since the problem is not technical (industries can clearly make such studies), progress can be made only by identifying those government policies and practices which need to be modified to encourage them.
- As an alternative to the usual methodology of examining nuclear damage to a highly interlinked industry by input/output models at the industrial level, this study has suggested an approach which looks at key processes, at an organization level one tier below the whole industry. This methodology assumes that such key processes would have wide applicability across a broad spectrum of industries, could be identified by a sophisticated terrorist group, and could create a paralysis of productivity which far exceeds the apparent physical damage.

III THE CONCEPT OF TERRORISM

In the heyday of aircraft hijackings, the western nations took the lead in the United Nations in an attempt to gain international cooperation in the prevention of terrorist acts and the punishment of the perpetrators. It is interesting that, with the notable exception of the agreement on aircraft hijackings, these attempts floundered primarily on an inability to define either a terrorist or a terrorist act. One group's terrorist is frequently another's liberator, whose actions are claimed to be justified by its objectives.

Definition of Terrorism

Most attempts at defining terrorism usually combine the criminal act with a political motive. Some illustrations are:

- "Terrorism involves the threat or use of violence for persuasion, coercion or publicizing the existence, grievances or causes of a particular group. Although the two often overlap, terrorism is separated from purely criminal activities by its devotion to political ends."[2]
- " . . . includes, but is not limited to, the calculated use of violence to obtain political goals through instilling fear, intimidation, or coercion. It usually involves a criminal act, often symbolic in nature and intended to influence an audience beyond the immediate victims."[3]
- " . . . to create a climate of fear and intimidation by means of threats or violent action causing sustained fear for personal safety in order to achieve social or political goals."[4]
- "Terrorism can be described as the use of actual or threatened violence to gain attention and to create fear and alarm, which in turn will cause people to exaggerate the strength of the terrorists and the importance of their cause. Since groups that use terrorist tactics are typically small and weak, the violence they practice must be deliberately shocking."[5]

There has been no general concurrence whether special statutes are required for the adequate prosecution of terrorism. Mr. Thompson S. Crockett[6], Office of the Deputy Attorney General, Emergency Program Center, Department of Justice feels that a broadening of the definition of "assault", used in combination with existing criminal statutes, is adequate. Most terrorist acts are adequately covered by both Federal and state laws, causing a problem, if any, in concurrent jurisdiction. However, the spate of new state laws suggests the opposite opinion. These have been reviewed in

some detail in a recent report[7] for the National Governors' Association, and will not be further pursued in this report.

Objectives and Current Status of Terrorism[8]

The above attempts at defining terrorism all tacitly recognize that for this case the crime committed cannot be separated from its motivation, which leads to a discussion of the origins and objectives of terrorism. The concept of terrorism is the achievement of political objectives by an idealistically or ethnically homogeneous group through coercive pressure on political authorities by threats or acts of violence to uninvolved people. The groups commonly using this technique are: separatists who have been regionally isolated by religion or tradition; political activists having a common ideological bond; religious fanatics; ethnic minorities; or majority representatives of splinter groups seeking to initiate or accelerate the disintegration of traditional geo-political spheres.

It is generally recognized that the terrorist movements have had uniquely national origins, although many have drawn upon a common base of Marxist idealism. These concepts, as they diffused out from senior ideologues into the universities of many nations in the 1960's, were the initial basis for what was at first purely symbolic, and generally non-violent, acts. The objective was principally to publicize a cause and gain support from the uncommitted general public. Frequently there was no specific group of authorities being addressed through coercive negotiations, there was no specific intent to kill, and resulting property damage was only incidental to the primary objective of forcefully calling attention to a cause.

In the early 1970's terrorism began to follow new and radical avenues of coercive power. Although the ultimate objectives of political change remained the same, the method of bringing it about, and hence the short-term objectives were quite different.

- Mass murder became the chosen vehicle for getting attention.
- It was important to demonstrate the impotence of authorities to protect the public.
- Public acceptance through the appearance of omnipotence was substituted for moral persuasion.

However, as terrorists perceived that mass murder was so repulsive as to be counterproductive to their ultimate objectives, their methodology shifted to the taking of large groups of hostages. The frequently protracted negotiations following such hostage-taking served several objectives in addition to avoiding the onus of murder.

- It elevated their stature by negotiating as equals with governments.
- It provided prolonged media publicity.
- It avoided governmental and public backlash.
- It avoided internal dissention arising from excessive violence.

Although the precise evolutionary status of terrorism may vary somewhat from nation to nation, over the last several years the frequency of incidents and the level of associated violence has remained rather constant.

As a final comment to this discussion of the objectives of terrorism, it might help to note several things that terrorism is not.

> " . . . the mind of the West is cluttered with two mindless cliches. One is that terrorists are 'desperate' people. The second is that terrorism is 'senseless.' Terrorism would not be such a plague if either cliche were true. Neither is."[9]

Many terrorists have been drawn initially by an intellectual ideology having at least as much appeal to the middle and privileged classes as the deprived and desperate. In addition, desperate people axiomatically require rapid alleviation of their plight just for survival, whereas, terrorist groups are more generally dedicated to a prolonged and open-ended fight for their objectives. And, far from being "senseless", terrorism is attractive because it has been so successful.

> "Far from being 'senseless', much terrorism is 'sensible' because it is (in the argot of the day) 'cost efficient.' Or, to borrow the language of the stock exchange, terrorism is 'highly leveraged.' Even sporadic terrorism can make necessary the constant deployment of defenses. Furthermore, the effectiveness of terrorism is enhanced by instant and mass communication."[9]

It is always difficult to see current trends with particular clarity. There are examples in which isolated terrorist events evolve into larger and more continuous guerrilla warfare: Northern Ireland, Iran, and

Nicaragua, for example. But in general it appears that the coercive power of terrorism is declining. Public support continues to wane, which in turn has allowed a stiffening of laws for its control. At the same time there has been an increase in mostly informal cooperative arrangements between like-minded governments for the exchange of information. Counter-terrorist efforts are also being aided by many forms of modern technology, primarily in the area of automated information management. A much more detailed monitoring of people crossing international borders, in conjunction with automated files of fingerprints, voiceprints, and handwriting, has made possible some degree of tracing terrorist movements. Finally, cooperation has grown between the press and government negotiating authorities during hostage events. The police have come to understand that press support is absolutely vital and must be retained even at the expense of some operational problems which are sure to arise. Similarly, the responsible press appreciates the dangers and complications implicit in independent and uncoordinated communications for negotiating with either the terrorists or the hostages.

The Potential for Nuclear Terrorism

Brian Jenkins[8] noted that the decline of terrorism over the last two years is the combined result of both the authorities becoming more successful at combatting their actions and at the same time their actions drawing less publicity. This plateau of effectiveness suggests that terrorism might be at a threshold of escalation or a shift in direction, which could lead to nuclear terrorism having the potential for the mass destruction of people and property. Since we lack clear insight into the terrorist decision-making process, and also recognize that there is likely to be considerable variation among terrorist groups, we can only speculate as to how they might evaluate their present situation. If terrorist acts are only to fill an internal psychological need, the current level of action could continue indefinitely. If the need demands a constantly increasing level of coercive shock, however, then escalation may be the alternative.

Any form of mass murder, no matter how strongly rationalized in terrorist eyes, will also be subject to several constraints. There is a moral dictum against killing a large number of uninvolved people in even

the most hardened group. This is particularly true in hostage situations, in which many observers have noted that the rapport developed during the protracted captive period appears to erode the terrorists' will to carry out their threats. Also, terrorists probably recognize that their activities have frequently alienated people whose sympathy to their cause was desired, and it would be reasonable to assume that even higher levels of thoughtless murder would lose them additional potential constituents. Government authorities, then having a reinforced popular mandate, supported by public fear and frustration, will be provoked into extreme forms of backlash. Finally, nuclear terrorism would probably require a larger number of participants, engaging in even less socially palatable actions than in conventional terrorism. This potential for internal dissention would increase the fear of betrayal by disaffected members.

On the other hand, there are possible terrorist perceptions through which these constraints might be nullified, or at least eroded to some extent.

- Prejudice, such as when the victims are from a different ethnic group, makes the mass murder victims appear a little sub-human.
- Religious fanaticism has been made to justify almost any action.
- Vengeance against real or perceived wrongs is commonly rationalized with ever-increasing levels of violence.
- A terrorist group threatened with extinction may adopt an "all is lost" syndrome, leading to a final act of desperation.
- The brutalizing effect of a protracted struggle, which numbs the public and the terrorist alike, reduces the impact of an escalation.

Although terrorism was initially based on meeting idealistic objectives, it has now evolved to where terrorism itself has become the ideology. "The terroristic scene" survives the faith of the group which initiated it, attracting a new class of people who may have the common criminal tendencies towards psychopathic murder, or desire for power or money.

Although quantifying the probability is difficult, nuclear terrorism is not implausible. Nuclear issues are currently so much in the public mind that this alone greatly increases the possibility of its becoming a terrorist weapon. The reactor accident at Three Mile Island, the problems of reactor waste disposal, the health implications of troops exposed during the atmospheric nuclear test program, and the

Karen Silkwood plutonium contamination case are illustrative of the near daily press attention which has kept nuclear issues constantly before the public. This helps create an aura of "nuclear is special" that is not matched by either chemical or biological weapons, even though the latter are potentially, at least, as effective, available, and easy to use. Another factor which would seem to make the use of chemical or biological attacks less likely than nuclear is that terrorists tend to imitate nations, who have generally legitimized the development and threatened use of nuclear weapons, while almost universally condemning the use of chemical and biological weapons.

Nuclear threats can be made which cover many levels of potential severity. To this point essentially all nuclear threats have, after quiet investigation, been held to be hoaxes, with a credibility small enough not to require public evacuation or other extreme precautions. However, the advent of threats with greater credibility, requiring a series of precautionary public responses, will have the adverse effect of further popularizing the appeal to terrorists and other would-be terrorists, probably leading to a series of false alarms. These could, in turn, produce increasing public apathy.

Nuclear terrorism could also take the form of disseminating radioactive material, where the appeal would be to groups objecting to nuclear power or weapons. The objective would likely be the contamination of property rather than to pose a direct health threat to people. The contaminating material is likely to be either reactor fission product waste, which emits penetrating beta and gamma rays, or plutonium, which emits essentially only alpha particles. However, either type could present a severe cleanup problem, requiring extensive expenditures of labor and material, in addition to causing major disruptions to normal activities over a wide area and a long period of time. Finally, a nuclear explosion constitutes the ultimate threat, to be discussed in the next section.

In summary, we cannot say that a terrorist nuclear threat is credible and likely at the present time. Yet even a low probability, since it must be combined with a potential for massive damage to people and property, requires that it be given serious contingency planning.

IV NUCLEAR DEVICE PROPERTIES AND LOCATIONS

This chapter will address the possible sources of a terrorist nuclear weapon, its assumed properties, what places terrorists might select for its detonation, and current technical capabilities to locate the hiding place.

Weapon Source and Size

It is conceivable that a terrorist group might develop one of several sources of nuclear weapons.

- There is a slow but steady increase in the number of nuclear powers, with the more recent members, and those countries thought to be near-members, tending to be smaller nations. Some of these nations are known to have strong and long-standing antipathies, while being less constrained by the power structure of major national blocks. This raises the potential for national sponsorship of terrorist activities by providing design and materials assistance, or an actual completed weapon. Such action, amounting to surrogate war, could place in terrorist hands devices or weapons having significant yields.
- In principle, a nationally designed weapon could be stolen and detonated by a terrorist group. If successful, such an explosion could be of almost any size up to a very high yield. However, the combination of heavy physical security and "locks" on the weapons themselves suggests that a successful theft and detonation is quite unlikely. In addition, since a successful theft would be immediately known, the necessary clandestine preparations for the explosion would be much more likely to be discovered.
- The required nuclear materials from which the terrorists themselves could design and fabricate a nuclear explosive could be stolen or acquired. The feasibility of such a source, focusing on the availability of appropriate fissionable materials and adequate weapon designs, has been the subject of extensive, and frequently knowledgeable, speculation.

Without pursuing the credibility of any of these potential sources, the study assumes a terrorist-designed weapon having a yield of 1 KT, midway in the 0.1 - 5 KT range of yields most often speculated in the extensive unclassified writings on the subject. Finally, even though the yield is small, the device is assumed to be large and heavy enough that it cannot be transported by hand. Specifically, the often-discussed small, lightweight "suitcase bomb," which could be easily hidden and transported by a single individual, is not credible as the initial design of a

terrorist group having general technical competence but using material of uncertain effectiveness and lacking direct weapon design experience.

Location

There are several classes of targets potentially of interest to nuclear terrorists:

- Urban areas
- Industrial targets
- Remote and uninhabited areas
- Foreign soil

Potential foreign soil targets are likely to be either U.S. military forces or industrial interests. So, although management of the incident will be through either State or Defense Department channels, the nature of its physical target itself is no different than those in the U.S.

It could be logical that a terrorist group would detonate a weapon in a remote, uninhabited area as a visible demonstration of its credibility but without the onus of mass casualties and property damage. Such an action would maximize the coercive impact of a subsequent threat against a population center by the same group, whether or not they in fact had a second weapon. Thus requirements for FEMA planning for mitigation in the remote threat would be covered by the case of urban threat planning.

Whether an industrial or commercial target is selected depends on the objective and the degree of damage required to achieve it. Such targets will continue to be attractive for protests and symbolic actions, and may also become so for the distribution of radioactive contamination. However, a significant nuclear explosion will generally not produce mass casualties should that be the objective, and is totally unnecessary if paralysis of the functional operation of the facility is desired. Assuming physical access is available, as would be required to implace a nuclear weapon, numerous studies have shown that conventional explosives are adequate to destroy key parts and cripple production for extended periods.

For these reasons the urban setting of tall buildings in the commercial district of a large city has been selected for the study. It meets the terrorist objective of threatening the largest population density, causing the maximum property damage, and being directed towards an area

familiar to most people. Specifically, the street and avenue pattern of Manhattan has been used for the rectangular grid in the blast attenuation calculation. Alternatively, a relatively open environment of broad avenues and numerous parks, surrounded by low (3-5 story) buildings, similar to the Federal area of Washington, D.C., would not likely demonstrate a significant deviation from the readily available weapon effects data.

Terrorist Nuclear Bomb Disposal[10]

The Atomic Energy Commission (and its successor agencies, ERDA and DOE) has long had the responsibility of responding to nuclear weapon accidents with appropriate equipment and trained personnel. The task was primarily one of search for missing components and cleanup of radioactive debris following dispersal by high explosive or fire. More recently this continuing task has been supplemented[11] by another, to respond to threats of nuclear terrorism.

This responsibility has been implemented by the formation of a Nuclear Emergency Search Team (NEST) which constitutes 150-200 people drawn primarily from the three weapons laboratories (Los Alamos Scientific Laboratory, Lawerence Livermore Laboratory, and the Sandia Corporation) and a contractor (EG&G) using equipment built by EG&G. NEST is under the operational control of the Nevada Operations Office (DOE/NVOO), having its main base in Las Vegas, a second group at Andrews AFB, Md., and with additional equipment stored at Travis AFB. Although all the individuals involved have other, full-time jobs, the NEST teams' alert status is two hours ready to depart from their respective air base, where high-priority transportation is provided by the Military Airlift Command. An emergency response by this group has been required on the average of once a month.

The DOE does not take charge of any nuclear event. Its primary function is in a support role to provide scientific and technical expertise in the field of nuclear weapons and nuclear materials. Within the U.S. they report to the FBI, with the NEST group reporting through the special agent in charge of the field operation and through the liaison officer at the Emergency Operations Center of DOE in Washington. Outside the U.S., DOE serves the DOD if a U.S. nuclear weapon is involved or, at the invitation of the foreign government, under the State Department if it is not a U.S. weapon.

The nuclear threat response is considered in several phases:

- Threat assessment
- Search
- Identification and diagnostics
- Render-safe or mitigation
- Cleanup

In view of the extensive history of nuclear threat hoaxes, an accurate threat assessment is vital to preparing an appropriate response. The FBI provides the DOE with all available information as to the technical design of the nuclear device, as well as the exact wording of any communications from the terrorists. The DOE Emergency Action Coordination Team (EACT), using both this FBI data as well as any additional that may have been supplied by the NEST team, provides the FBI with its best assessment of the credibility of the threat using both technical and psycholinguistic techniques.

The search is made using a wide variety of portable radiation detection equipment, ranging from handbag and briefcase covert detectors to van, helicopter, or light aircraft-mounted units at the other extreme. Some of these must be manned, with the readout at the instrument itself, while some of the larger units include a small transmitter capable of forwarding signals to a manned recording station as much as a mile away. But it is assumed that in general the team will be working out of public view. A stand-alone, prepackaged, air-transportable communications system is available for deployment with the NEST team.

In the search phase there are really only two types of detectors used. One is a very sensitive sodium iodide gamma-ray detector, similar to those used in civil defense, but sensitive in the micro-rad range. The other is a rather conventional enriched (in B^{10}) boron triflouride proportional counter to detect moderated neutrons. Thus, neutrons and gamma rays are the only useful radiations from nuclear materials capable of penetrating conventional packaging materials and the air to a reasonable search distance. Detection ranges are very dependent on the precise nature of the nuclear materials involved, but generally will be from tens to perhaps three hundred feet at the most. In the search phase there is no attempt to identify either tritium or high explosive.

Search is usually made by pairs of men, but a broad search area can easily saturate the total NEST response capability. Specifically, they do not have either the equipment nor manpower to handle several simultaneous searches. Thus, search effectiveness is highly dependent on a rather specific location of the target by the terrorists, on there not being a rapid or simultaneous series of hoaxes, and on the absence of a series of real events in close sequence. In summary, a high reliance should not be placed on the successful location of a clandestine weapon, even with several days' time available for search.

Once the suspected nuclear device has been located, additional specialized equipment is used in an attempt to diagnose it more precisely. Radiography, using either a portable x-ray or nuclear isotope gamma-ray source, is frequently used to reveal structural details. Through data provided by the equipment, an attempt is made to assess the amount of high explosive (HE) involved, the type and amount of nuclear material, and the yield potential of the device (using also any intelligence information relayed through other channels--i.e., the threat warning itself). The DOD Explosive Ordnance Disposal (EOD) personnel provide advice and assistance to the NEST team in its assessment, as well as having responsibility for locating and deactivating any booby traps that may be associated with it.

The render-safe phase is the primary responsibility of the DOD/EOD team, with the advice and assistance of the DOE/NEST people. Although, in principle, it might be feasible to deactivate the device for safe removal, it is felt that in practice any terrorist group capable of fabricating a credible nuclear explosive will also have designed it so that it is not easily or safely disarmed. Thus, in-place destruction by a shaped charge explosive is usually assumed, accepting the detonation of the explosive which is part of the device and the associated dispersal of the toxic and radioactive nuclear material.

The potential for mitigation of the explosive force itself, should the total destruction by a shaped charge fail, is extremely limited. Potentially some mitigation is available by directing the blast by the use of bulldozers to selectively mound material, or by deploying some scavenging material of partial effectiveness against the radioactive

debris. But the primary plan must remain to explosively destroy it in place, accepting the attendant spreading of radioactive material.

The final task is that of cleanup, for which NEST will give technical assistance as advisors and whatever other assistance may be feasible. However, DOE feels it does not have adequate assets in either manpower or equipment to take primary responsibility for cleanup even for the relatively small detonation associated with a successful destruction of a nuclear device, to say nothing of the much more extensive problem resulting from a successful nuclear detonation or a deliberate dispersal of radioactive material. The large number of trained personnel required for the cleanup phase will have to come from elsewhere, for which the NEST people plan to notify the DOD and civilian agencies.

In this connection it should be noted that FEMA field groups normally have available only beta and gamma-ray detectors appropriate to CD functions, but not the alpha-particle detectors that are likely to be required in a terrorist nuclear event. In this connection it is very important to note that FEMA does not have a stock of chemical and biological detectors that would be required should terrorists turn to these agents.

In addition to the threats, averaging one a month, to which the NEST teams react, the DOE does do exercises, both command and control types as well as planned field exercises requiring deployment of people and equipment. These are under the control of its Emergency Operations Center, which is tied in turn to the White House "situation room", the FBI, the CIA operations Center, and the National Military Command Center. DOE strongly supports the necessity for such exercises, in spite of the planning time required, the cost, and the artificiality inherent in the simulation of senior people who cannot take the time to participate.

V CONSEQUENCES OF NUCLEAR TERRORIST EXPLOSIONS

This chapter addresses some aspects of physical weapon effects in urban environments, develops an approach for evaluating the economic impact of attacks against key industrial elements and discusses several possible functional and psychological consequences of nuclear terrorism.

Small Nuclear Weapon Effects

The nuclear threat to a large city to which a civil defense program is keyed is usually taken to be one or more multimegaton weapons, burst at a height to maximize damage against urban-industrial structures. The environment produced by such a detonation has been extensively studied and is generally well understood and documented.[12]

The general scale of phenomena for a typical 5 megaton burst detonated at an attitude (4.4 km) selected to optimise 10 psi overpressure on the ground can be noted from several typical ground ranges: 3 km for skin burns (4 cal/cm^2), 8 km for collapsing buildings (10 psi overpressure), and 20 km for lethal glass fragments (2 psi). The tallest buildings are at least an order of magnitude smaller than these distances, with even the World Trade Center having a height of only several hundred meters. The gross features of the nuclear effects from such a large burst will not be significantly modified by even such massive structures. The interaction of the elements of this environment with typical urban structures has been systematized in a form useful to civil authorities.[13]

Important differences exist between the effects from a high-yield weapon air burst over a city and a terrorist-developed weapon detonated within a complex of tall urban structures. The greatly reduced range of lethal effects from the much lower yield terrorist design, which we have hypothesized to be 1 kiloton, can be readily recognized from free-field data contained in current weapons effects documentation. The distances for skin burns, collapsing buildings, and glass fragments equivalent to the 5 MT case above are approximately 600, 300, and 900 meters respectively. In addition, low-yield weapons are dominated by the prompt nuclear radiation environment, which for the illustrative case will produce a highly-lethal 750 rads out to 700 meters from the burst. But, since all these distances are comparable to block and large building dimensions, the nuclear environment will be significantly modified by the structures.

Before discussing this modification, it has been questioned whether there will be design differences between the professional nuclear weapons on which handbook data are based, and a terrorist design, which could produce a significant variation in output. This question, addressed to Mr. Duane Sewell, the Assistant Secretary for Defense Programs of DOE, received an answer[14] which essentially confirms that the same weapon output effects data could be assumed.

> Department of Energy (DOE) studies on damage limitation (from terrorist-caused nuclear explosions) use as their basic data the information given in "The Effects of Nuclear Weapons" (third edition, 1977) by Glasstone and Dolan as our laboratories regard it as an authoritative source. Any differences due to terrorist design parameters are taken to be minor in comparison to yield uncertainties inherent in improvised device design. These studies are reformatting some of the data for more rapid reference use and interpolation.[14]

As was noted in the previous discussion of the possible location of a terrorist nuclear bomb, the physical properties of the immediate surroundings can strongly modify the explosion effects. Of the several locations discussed, that of a van or light truck parked in the street between tall buildings would be expected to produce the least modification. It is also assumed that a terrorist group would lack the capability of detonating it off the ground at a height such as to maximize its range of lethal effects in a manner analogous to military weapon systems.

A rather qualitative assessment has been made of thermal, fallout, and initial nuclear radiation effects, specifically with the objective of bracketing the potential variations from handbook data. For very large nuclear weapons at great range the fireball radiation will be the dominant lethal effect to unprotected people, at intermediate yields and moderate distances blast effects will be the dominant factor, while for low yields and short range the initial nuclear radiation will control. This general discussion of effects will be followed by a summary of an initial, more elaborate blast transmission calculation making use of a grid of stylized urban buildings.

Thermal Effects[15]

The fireball of the 1-KT nuclear explosion radiates approximately one-third of its energy in a pulse of thermal radiation having the potential

for causing eye damage, skin burns, or fires in combustible materials. The rate of emission of this thermal energy will rise to one peak at 80 microseconds, fall to a minimum at 3 milliseconds, and rise again to its final maximum at 43 milliseconds. Over 99 percent of the total thermal energy is emitted in this last pulse, with the majority of it emitted in several tenths of a second.

The intensity of this radiation decreases with distance both by simple r^{-2} spreading, as well as by atmospheric scattering and attenuation. The visibility range will generally be greater than a mile in even an urban environment, and thus optical absorption in the air will not strongly influence the thermal energy from a 1-KT burst in which distances of interest will be less than a mile.

In free air at atmospheric pressure the fireball radius is $55W^{0.4}$ meters with a thermal partion (fraction of total energy emitted as thermal) of 0.36. For a surface burst the fireball volume will be approximately the same, or a radius of the hemisphere of $55(2W)^{0.4}$, with a thermal partition of 0.21. This drop in thermal partition as the fireball tounches the ground accounts for the thermal energy which goes into direct heating of the ground or dust ejected into the fireball rather than being radiated directly from the free surface. Thus the free surface burst fireball radius will be 73 meters.

In the illustrative case of a detonation in the middle of a 26-meter-wide street, the fireball will be confined between the adjoining buildings, with some small fraction escaping into the building interior through window openings. If it is assumed that the fireball volume is the same as in the free air case, but reduced by the thermal partitioning ratio (.21/.36), the resultant fireball shape will be a short half-cylinder of length 26 meters and a radius 107 meters. If a person were exposed down the street to this cylindrical edge he would see an approximately rectangular surface of 26 x 107 meters, or 0.34 of the free radiant surface of exposure of the hemispherical fireball. The same analysis for a 40 meter avenue gives a fireball of 0.42 fractional area. These estimates are probably conservative in that the thermal partitioning will likely be even less than 0.21 because of the two building surfaces contributing to direct fireball energy loss.

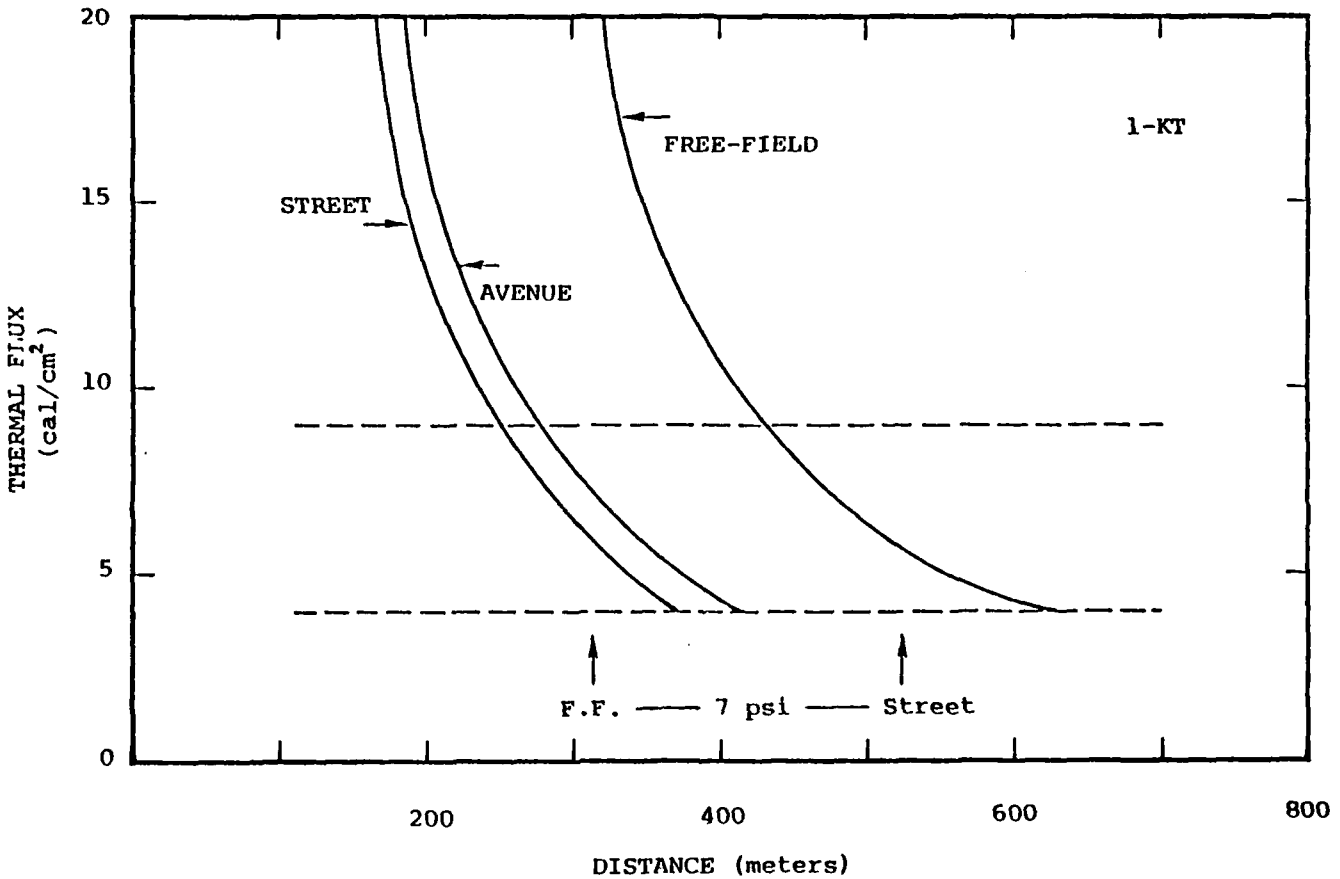


Fig. 1 1-KT THERMAL FLUX

The thermal flux required to cause skin burns depends somewhat on the yield of the bomb, with less required at lower yields in which the deposition time is shorter. At 1 KT it is assumed that 4 cal/cm^2 will cause second degree burns, 9 cal/cm^2 will cause 50% lethality, and 20 cal/cm^2 will be 100% lethal. Fig. 1 shows the range of thermal radiation from 1 KT for the free field case (surface burst on a smooth plane) and the two urban cases discussed above, in which the smaller radiating surface of the fireball allows a closer distance of approach before reaching a given thermal flux level. The space between the dashed lines (4 and 9 cal/cm^2) is the region of rapidly increasing burn casualties for those directly exposed in a street.

A blast pressure of 7 psi will heavily damage concrete office buildings, producing numerous casulties. The arrow at 315 meters shows the maximum radius of this pressure in the free field example. Since thermal burns extend out to the 430-650 meter range, they would have to be considered for the free-field case. However, the reverse is the case in the urban environment. The preliminary study[16] of blast attenuation in an area of tall buildings (discussed later in this report) indicates a significant degree of canalization down streets, with 7 psi propagating to 525 meters. Since the range of rapidly increasing thermal burn casualties is 250-400 meters, thermal burns can be discounted in setting minimum safety distances even for unprotected personnel directly exposed down the street.

Fallout

The fallout pattern from a nuclear weapon, which will occur whenever the fireball touches the ground, depends not only on the weapon yield and to a certain extent on its nuclear design, but also particularly strongly on the detailed atmospheric parameters of wind velocity, temperature, and turbulence, and their variation with time and space. Although these data are generally unavailable in sufficient detail to predict the fallout pattern with great precision, its general form and intensity can be determined from direction, velocity and shear data.

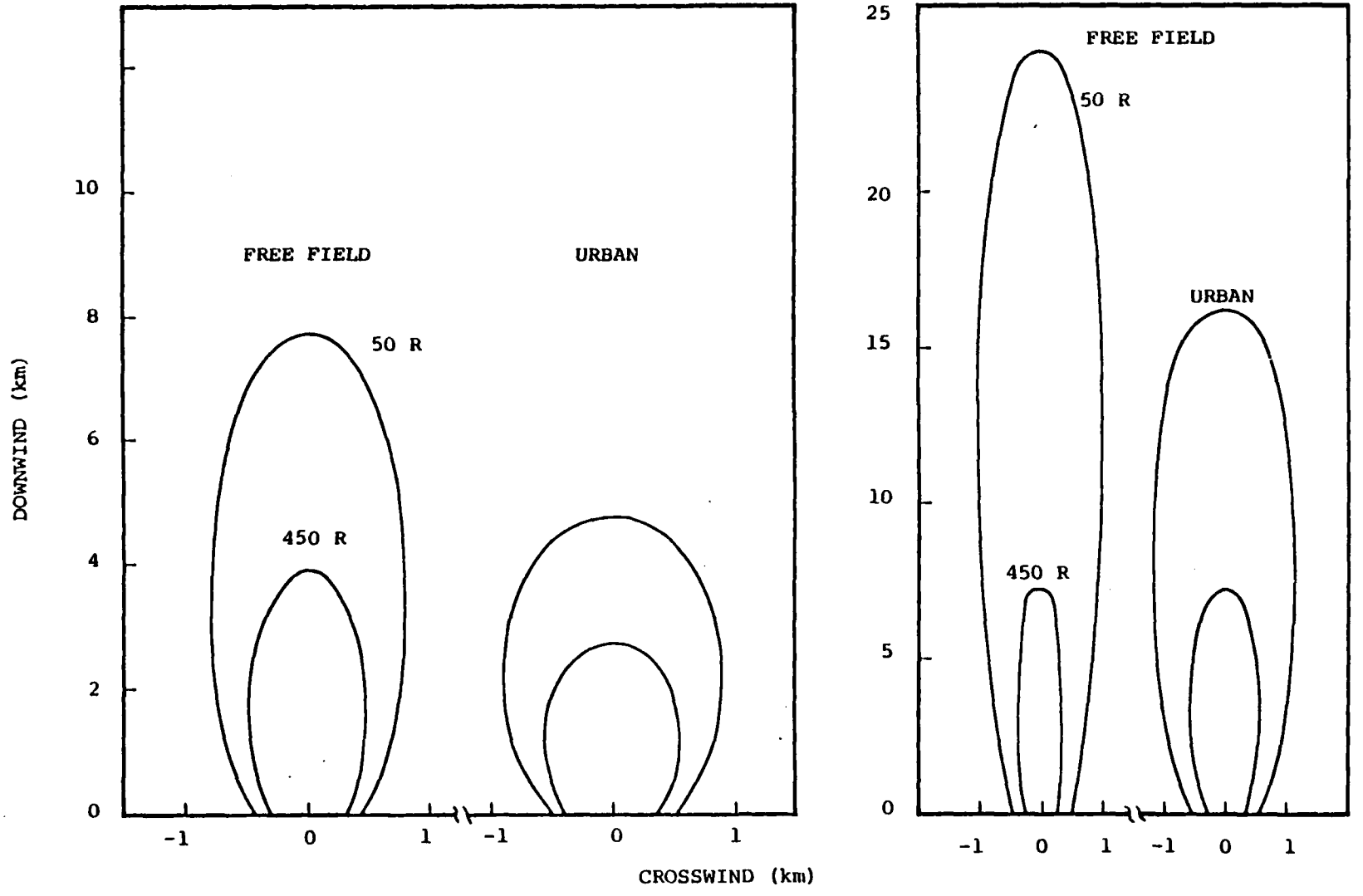
Fallout radiation at any specific downwind location does not commence with the nuclear explosion, but depends on the time of arrival of the debris cloud. It builds up rapidly as additional material is deposited from the passing cloud and then slowly decays through normal radioactive

decay, weathering, and other environmental factors. Since arrival times for the 1-KT yield will vary from one-half to several hours, depending on wind velocity and downwind distance, and the distances involved will not extend beyond tens of kilometers for lethal doses, movement out of the exposed area will be feasible and protracted exposures need not be considered.

The fallout pattern from a low-yield nuclear weapon detonated on the ground in an urban environment will deviate from that of a weapon detonated on a flat, open surface in that the rate of ballistic rise of the buoyant gasses will be reduced by additional energy lost to adjacent buildings and the additional time required for replacement air to arrive through the restricted channels between tall buildings. Since the debris cloud will not rise as far or as quickly, the extent of the fallout pattern will be reduced.

A quantitative comparison has been made based on the extreme assumption that the 1-KT urban detonation distributes its debris as if coming from a hot gas bubble of ½-KT containing 1 KT of fission debris. Specifically, calculations[15] derived from the SIDAC fallout radiation model are used to compare a 1-KT surface burst to a ½-KT surface burst pattern of doubled fallout intensity. Two cases of wind velocity (2 and 10 knots) have been used, with no wind shear assumed in either case. The 50 and 450 rem dose contours have been calculated integrating from the time of arrival of the fallout at any point, over the subsequent 24 hours, assuming no shielding. This is unrealistic in a structured, urban environment, but will serve for making comparisons.

Figure 2-A shows the 1 KT pattern for 2-knot wind, while 2-B is for 10-knot wind. In each case the pair of curves on the left are for the 1-KT free-field data, while those on the right are for the ½-KT dispersal doubled in intensity, representing the urban environment. In each pair, the inner curve is the 450 rad, and the outer 50 rad, 24-hour dose contours. For the 2-knot wind case the urban environment produces a slightly broader pattern, but one which has been shortened in the downwind direction by about two-thirds. For the 10-knot wind, the 50 rad contour shows the same characteristic fore-shortening, while the 450 rad contour has about the same downwind length, but only two-thirds the width.



(A) 2- KNOT WIND

(B) 10 KNOT WIND

Fig 2. 1-KT FALLOUT PATTERNS

In summary, fireball cooling from adjacent buildings additional to that from a normal surface burst will somewhat reduce the extent of the fallout pattern, and hence the hazard to the total urban population. However, realistic uncertainties in the yield of the weapon, when combined with unknowns in the precise wind parameters, will force an overall degree of conservatism in predicting the fallout which will override the small pattern changes produced by the urban environment. But, nevertheless, these data indicate the fallout hazard will certainly not be more extensive than that suggested by conventional models.

Initial Nuclear Radiation

The initial nuclear radiation, that arriving at a target location in the first minute, is a complex mixture of neutrons and gamma rays coming from the bomb itself, its rising debris cloud, or arising as secondary reactions in the air or ground. Thus, an accurate calculation of the total radiation in even the free-field geometry of an explosion directly above flat ground and including transport through the air is a complex computer task, involving many absorption and scattering reactions for several elements for a distribution of neutron and gamma-ray energies.

Figure 3 shows this initial nuclear radiation for a surface-burst 1-KT bomb as a function of distance.[15] The upper right curve is the free-field case. The horizontal dashed lines give three illustrative doses that might be considered as limiting cases: 450 rads, for which the lethality rate is 50%; 50 rads, frequently used as the one-time emergency dose limit; and 2.5 rads, the annual industrial dose limit. The two vertical dashed lines are the range of 7 psi blast overpressure for the free-field and street canalized cases.

People in the threatened area, but not directly exposed on the street in which the bomb is located, will have significant additional radiation shielding from the building structures between themselves and the explosion. A precise calculation of this additional shielding is dependent in a complicated way on the location of each individual and the precise intervening building geometry and materials. However, useful limiting estimates of the shielding can be made. It is estimated that a commercial building has an average weight density in the range 0.04-0.2 g/cm^3, when exterior walls, interior partitions, and floors are averaged over the total volume of the

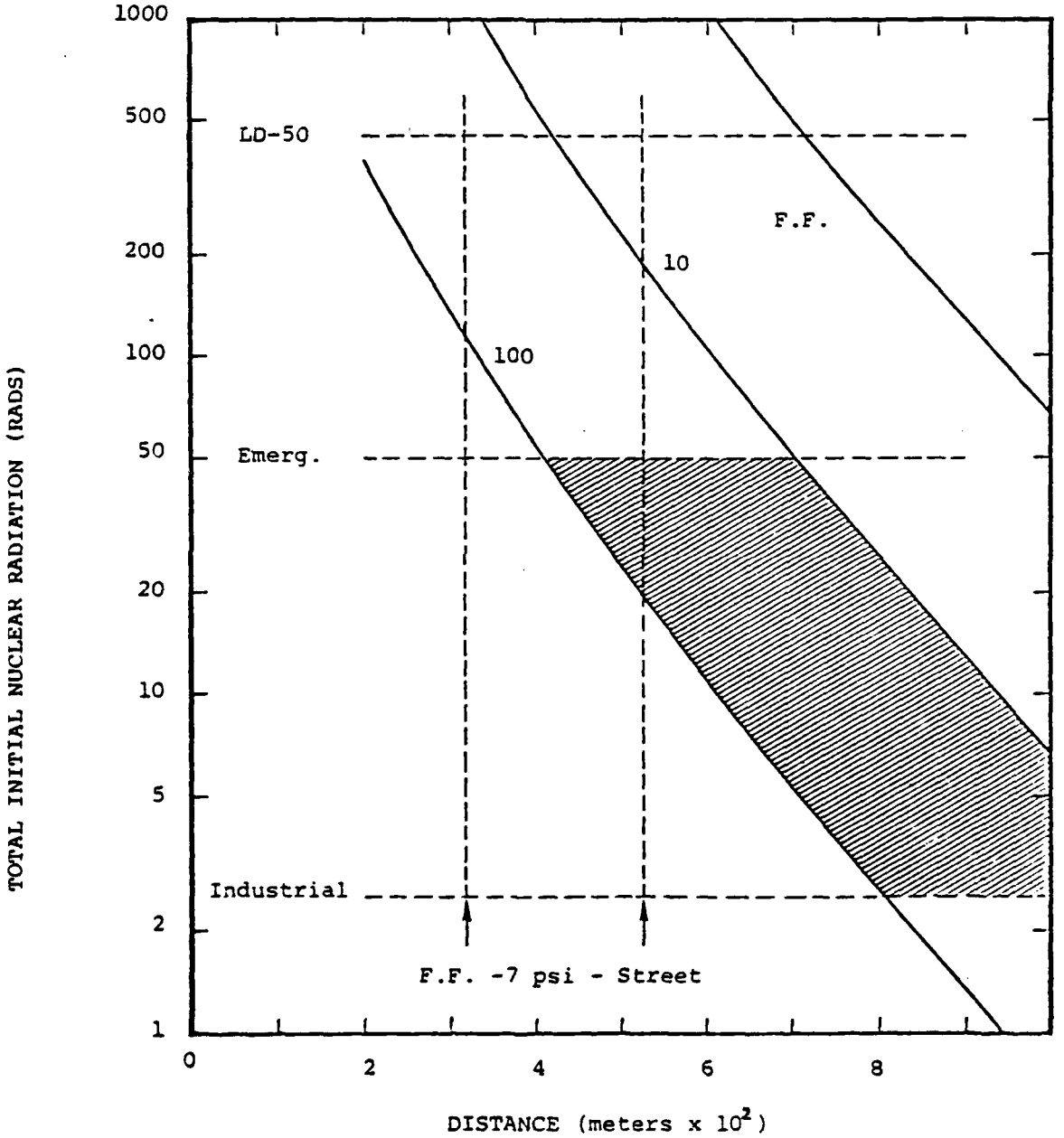


Fig.3 1-KT NUCLEAR RADIATION

building. Since the assumed short block length is 90 meters, the total average mass density horizontally through the structures of just one block would be in the range 360-1800 g/cm^2. For an "average" structural material, 90 g/cm^2 will reduce the radiation intensity by a factor of 10, so that the buildings of just one block would at first appear to provide a factor of 10,000 reduction in radiation intensity. However, scattering of radiation back down into buildings from the air above may limit this attenuation to a factor of 100.

The lines marked "10" and "100" in Figure 3 are the free-field initial radiation doeses reduced by these building attenuation factors. The space between these two lines is thus a conservative estimate of the probable radiation dose. If it is assumed that a dose in the range 2.5-50 rads would be the acceptable limit, then the cross-hatched area will be the limits of radiation in a urban area. Since it is quite likely that more precise computer calculations will show a shielding of at least 100, exposure distances as low as 400 meters might be feasible. But it is important to note that, whereas the 1100 meter range of 50 rads for the free field case was greater than the 550 meter 7 psi street blast range, the x100 attenuation now makes the 50 rad level go out to only 410 meters. Hence, the important conclusion is that the initial nuclear radiation no longer clearly dominates as the limiting lethal range when the explosion is in a highly builtup urban area.

Blast Propagation

An initial computer-modeled blast transmission calculation[16] has been made to explore whether significant deviations from the free-field data might be expected. A map survey of New York City suggested that a metropolitan area could well be represented by a uniform grid of blocks 64 x 140 meters separated in one direction by streets 26 meters wide and in the other by avenues 40 meters wide. All blocks are treated as rigid pillars, with no flow of material or energy into, through or out of buildings and no wall or ground drag. Since it was not felt appropriate to attempt a three-dimensional calculation in this initial effort, a quasi-three-dimensional geometry called the "X-Y wedge" was used as an alternative.

In this model the building-street complex is represented as an array of rectangular rigid blocks (in the X-Y plane) of infinite height separated

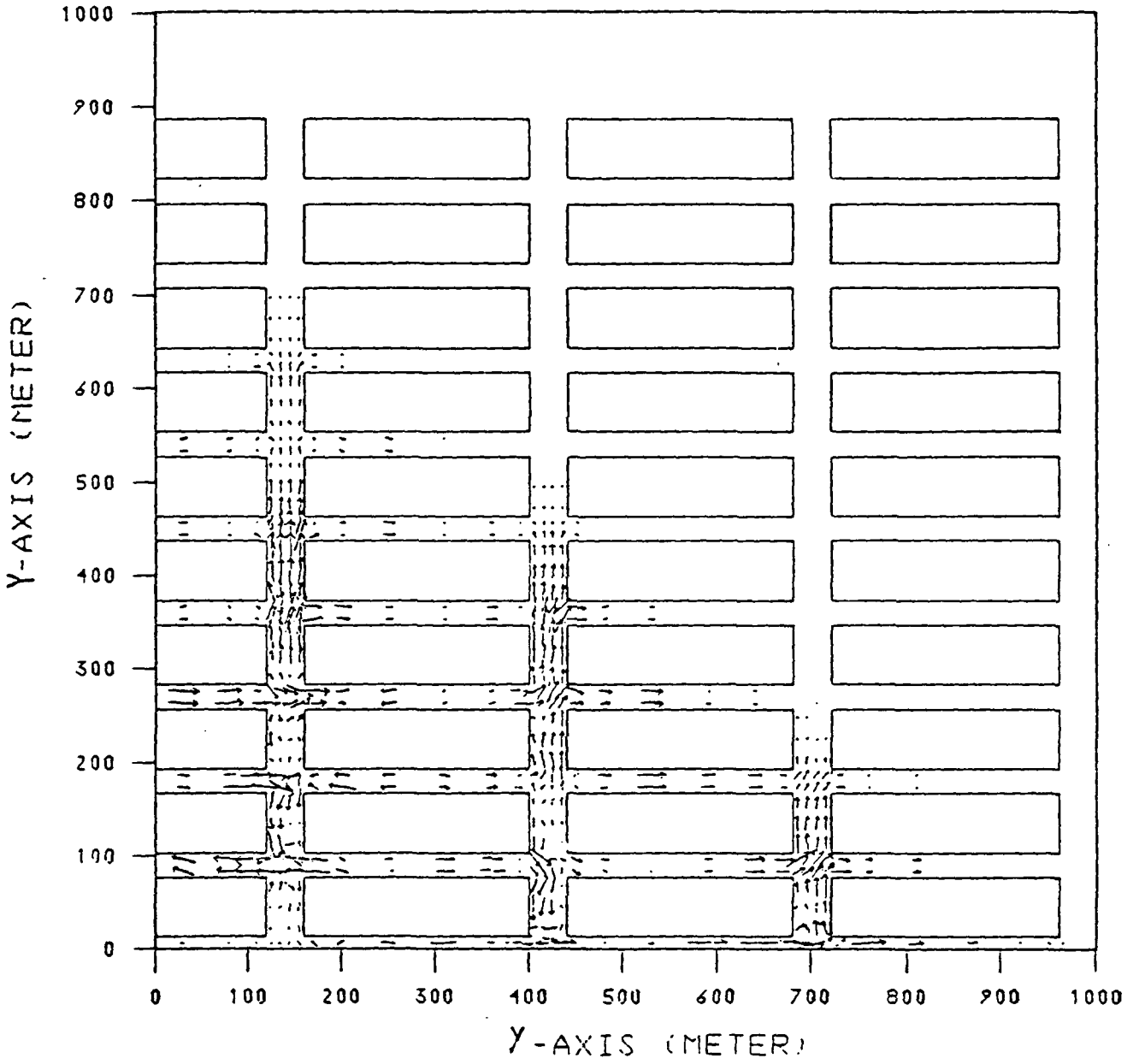


Fig. 4 URBAN MOMENTUM VECTOR AT 1.476 SEC.

by air-filled channels representing streets. The quasi-three-dimensional aspects of the modeling is achieved by allowing the effective volume of the calculational cells and the areas between cells to increase with range from the explosion point. The effective height (Z-direction) at any point R ($=\sqrt{X^2 + Y^2}$) from the explosion point increases linearly with R. The inclusion of this divergence means that in the limit in which no buildings are present the free-field environment would be obtained at all ranges. This geometry will restrict the vertical expansion of the blast wave as it impacts on buildings, and since the buildings are effectively of infinite height, no allowance is made for the wave moving over their tops. When results are presented later, the view will be from above.

The code employed in these calculations is called STREAK. The separate report[16] of this part of the study contains detailed data on the description of STREAK, the initial parameters of the air, zoning and re-zoning, and the parameters of the bomb source which initiates the blast wave. In brief, the latter was a one kiloton device in one metric ton of material (which included vaporized material from the van in which it was located) as internal energy in the four corner cells covering a surface area of 4 square meters. The source was located at the center of a block along a street, and thus was in direct view of that street, but not of any avenue.

The calculation was carried out to a time of 1.476 seconds after the explosion. Figure 4 shows the momentum field (density x velocity), in which the length of the arrows is proportional to the momentum and the direction that of the fluid flow. Pressure (as well as velocity and momentum) time history data were obtained at a series of points in the grid. An interesting feature noticeable in the figure is the approximately diagonal line the front makes. This is interpreted as being due to roughly equal conditions at equal path lengths from the source. The paths seem to begin at the first intersection encountered by the blast as it propagated down the street. This can be an important effect as it suggests that locations whose straight line distance would imply a given pressure value derived from free-field data may actually be subject to a lower pressure given by the path length down the streets and avenues. Other locations, especially those directly viewing the source, will be subject to a higher pressure, due to channeling effects, than that predicted by the free field.

The block-by-block detailed comparison is quite complex. A shock, upon arriving at a street intersection, is partly dispersed down the side streets, while high pressures can result in the middle of a block in which shocks converge simultaneously from the intersections at each end. But to summarize the results in general, the first clear effect is that any location directly viewing the source is subject to a stronger shock in the urban case than in the free field at the same range (at least under the assumptions made for this calculation). Second, side streets parallel to the main flow seem to be difficult to characterize. Those blocks close to the source where the flow has not yet been channeled experience lower values than in the free field, while stations along subsequent street blocks (where the flow is more channeled and collides with avenue shocks at intersections) seem to lie above the free-field. The avenues (which are perpendicular to the main flow from the device) apparently receive a disproportionately low share of the energy flow; and once one is far enough away from the first corner turned by the shock, the urban values fall below the free-field. Stations close to the corner are affected more by turbulence as the flow is trying to become aligned along the avenue and thus generate somewhat higher pressures in the urban environment.

Figure 5 illustrates the maximum extent of the 2.4 psi peak overpressure level for the two cases. (In the urban calculation there is some uncertainty, and local stagnations may yield overpressures above 2.4 psi. However, the general area bathed in this value is roughly as indicated in the figure.) There are two obvious differences, and these have been pointed out before. While at first glance one might expect the urban calculation to cover a larger area than the free-field (due to the excluded area of the buildings), this is not the case. Every time a shock turns a corner, directed kinetic energy must be re-directed. This results in an extra heating of the gas and a subsequent degradation of the velocity field. As a result of this thermalization of energy, the gas interior to the 2.4 psi contour is hotter in the urban case than in the free-field case. The 2.4 psi urban contour covers only about 70% of the area covered by the same contour in the free-field. However, the maximum range of this contour is about 30% larger in the urban case than in the free-field. Since the exact location of the device may not be known, the area threatened

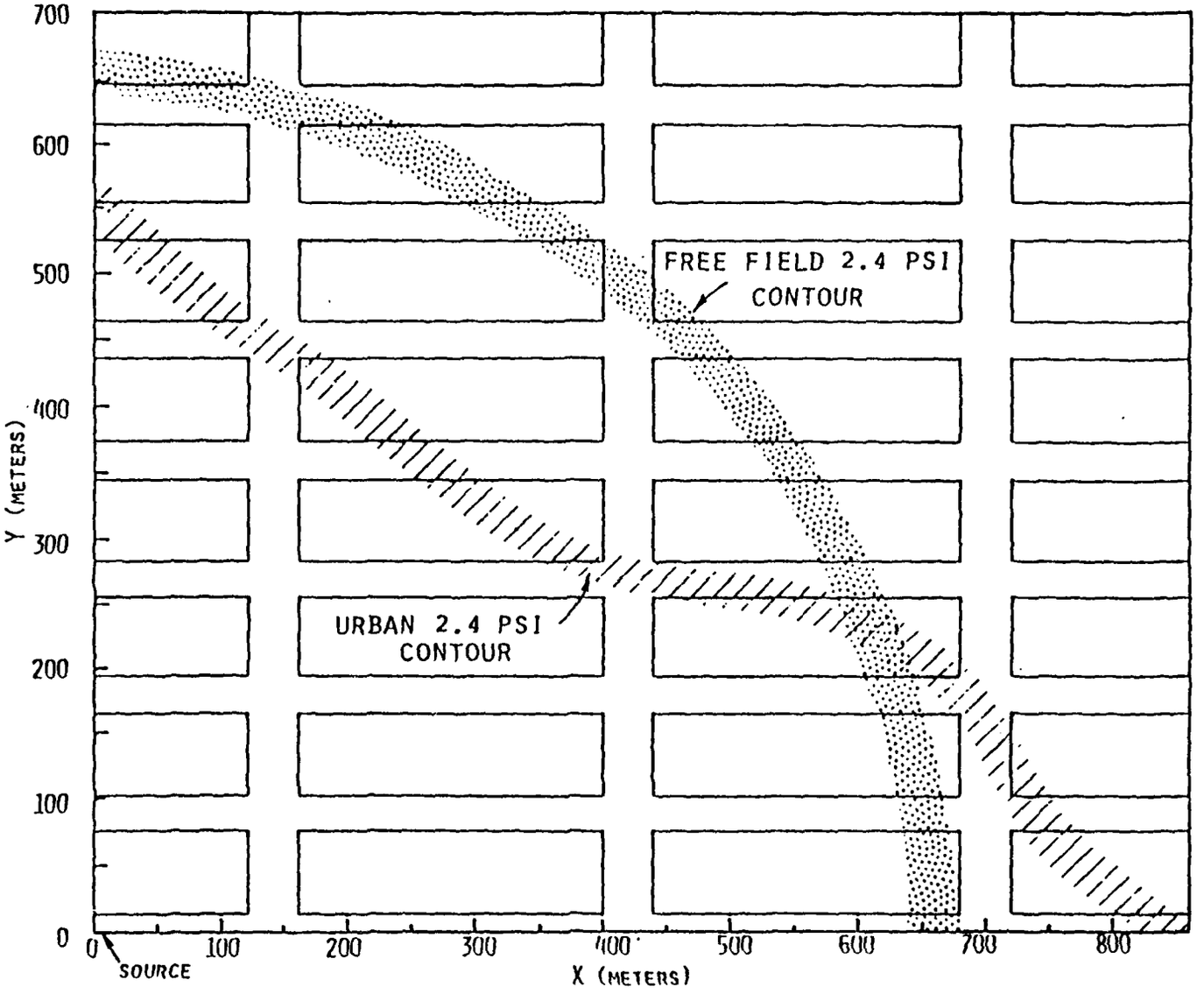


Fig. 5 1 KT. - MIDDLE OF STREET.

by these pressures is potentially included by this larger radius, which encompasses an area 70% larger than the free-field. A strategy for evacuation might be to use this larger radius as defining the area and then direct the evacuation out the diagonals, if possible, where the lethal range may be significantly less (by a factor of perhaps 2 if Figure 5 is accepted as a realistic representation).

In the street viewing the device the winds are in excess of 130 mph at the front, but up the other streets and avenues one finds nothing over 100 mph. There are turbulent eddies behind the shock fronts (usually at intersections) which have even higher velocities, and these areas seem to have about normal densities associated with them.

The urban calculation does point to different effects and results for a blast wave as compared to the free field. The code results appear reasonable considering the simplifications. Further possible improvements in the treatment of the X-Y wedge geometry such as 1) "vertical" expansion; 2) non-rigid buildings, 3) mass sources (to account for swept-up debris), and 4) allowance for finite building height, might help to refine these effects. Alternatively, further calculations with the current code with different source locations (e.g., in the middle of a building, in the middle of an intersection) may show other effects. A source in the middle of an intersection has two directions in which to expand rather than one and may yield different results. A source in the middle of a building (perhaps with the building removed) may behave yet differently from all others. A further investigation also should focus some effort on a detailed study of flow through an intersection with fine zoning. This would probe whether zoning may affect this flow, particularly with respect to the ability of the flow to turn a corner.

Key Industry Vulnerabilities

In discussing the objectives of terrorism, it was noted that there is frequently the desire to curry sympathy to a cause among potential constituents and thus directly influence government bodies and senior officials to change national policies in support of terrorist goals. When this direct objective cannot be achieved then an alternative can frequently be accomplished through a prolonged series of attacks: to deprive a legitimate government of its popular mandate by demonstrating that it is generally unable to protect its citizens and its institutions. Though not to deny

the effectiveness of such actions in influencing governments and achieving commensurate political goals, nevertheless the overall physical incapacitation to a nation through such actions is slight.

Industries, on the other hand, are not such useful psychological targets, with the exception of symbolic terrorism which has little direct effect on the business or industry involved. Acts of nuclear terrorism against business, industry or commerce would be intended to cause massive physical damage or functional paralysis (in the case of dispersed radioactive material). The objective could be to destroy the economic base of the nation through a series of carefully planned attacks against selected targets. Such a series of attacks would be particularly effective against our highly organized and interdependent society. They might be a clandestine attempt by a major power to severely impart the nations' ability to mobilize at a critical time.

This study has included a preliminary examination of the impact on the nations' industry should attacks be directed against key industrial processes.[17] This concept presupposes that manufacturing activities can be disaggregated into a series of processes which follow a logical, sequential order and can be arranged in a hierarchical pattern. Those low in the hierarchy treat and convert matter from raw to semi-processed forms, while those higher in the hierarchy convert semi-processed finished products. Finally, if industrial activities are viewed overall, similar processes are employed in widely divergent industries, defined according to the Standard Industrial Classification (SIC) system. "Similar processes" implies either that chemical and material or physical transformations are basically identical or that they require similar equipment. "Key" implies, therefore, something about both the pervasiveness and the essential nature of the changes.

The concept of "key" can be clarified when related to two other frequently used terms: "critical" and "nationally essential." An industry is "critical" if the final product is necessary to maintain a surviving population at some minimal living standard and not because of the processes it uses. "Nationally essential" industries are based on criteria that identify facilities essential to the maintenance of the civilian economy as defined by the U.S. Department of Commerce Industrial Evaluation Board. There is generally not a high degree of correlation between these

two lists of industries. An industrial process is key not because it produces a final product from a critical industry but because 1) the process is present in a large number of industries, and/or 2) the basic equipment required for the process is produced in a small number of plants.

Several alternative methods of identifying key industrial processes were considered: 1) the high risk area approach, 2) the flow chart approach, and 3) the elasticity of substitution approach.

1. The High Risk Area Approach: In its analysis of the potential hazards of nuclear attack, DCPA has identified 400 "high risk areas" which have been placed into three categories:

> Category I: These areas, designed as counterforce targets, contain strategic offensive military forces;
>
> Category II: These are other places of high military value;
>
> Category III: These are the balance of the places - about 265 - which contain urban-industrial complexes; not covered in other categories.

High risk areas identified for selecting "key processes" have been taken from among the Category III urban/industrial complexes. The four-digit SIC industries within each complex were identified. Since manufacturing industries generally depend on an abundant supply of labor, found mainly near towns and cities, their location is highly correlated with population. The concentration of industrial plants, classified by the four-digit SIC Code, was allocated by state, county and city. This code is a numerical classification system based on the final output of products which yields a breakdown that conforms most closely to the economic concept of "industry."

The aim is to correlate the Interim List of Nationally Essential Industries[18] and the Defense Civil Preparedness Agency (DCPA) High Risk Areas[19], especially those in Category III - urban/industrial complexes.* The economic profile of four-digit SIC industries of each urbanized area can be compared with the Nationally Essential List of Industries. In this

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*Category III urban/industrial complexes are compiled from Urbanized Areas listed within each State in Reference 18. Categories I and II are listed on pp. 12-21 of the reference.

study a single DCPA region was selected for study: Region I includes urban-industrial complexes found in Connecticut, New Jersey, New York, Massachusetts and Rhode Island. The total number of workers plus the value-added in manufacturing both for the individual states and the region was developed in the detailed report.[17]

Among the four-digit SIC industries identified for this region, only eight were found on the Nationally Essential List. They were concentrated in Connecticut, New Jersey, and New York; none was found in Massachusetts and Rhode Island. Employment in these essential industries was compared to the total employment on a state by state basis. In these three states employment in the nationally essential industries comprised 1.5 percent of total employment in the three states in which they were located, but only slightly more than 1.1 percent of total regional employment. By either assessment the clear conclusion is that nationally essential industries play a minor role in the overall industry of Region I. Thus, the high risk area approach was dropped from further consideration.

2. The Flow Chart Approach: To help categorize equipment used in alternative manufacturing processes, a group of 129 flow charts for four-digit industries was used from another DCPA report.[20] These flow charts of major operations indicate the high complexity of processes used in industries and can be examined to determine their ubiquity and to establish a common core employed in manufacturing. A general presumption is that common processes in different industries employ generally similar kinds of machinery and equipment. With more than 100 flow charts, processes can be tabulated for each four-digit industry showing their respective frequencies. The most frequently used processes can be submitted to closer analysis. However, this approach, if applied comprehensively to all processes would be very time consuming. Alternatively, two commonly-occurring processes were selected and evaluated, with resulting substantial questions as to the substitutabiltiy of like processing equipment amongst dissimilar industries.

3. The Elasticity of Substitution Approach: Underlying any production process, there is a production function which expresses a technological relationship, determined by the state of the art, between factors of production which are required inputs per unit of output. The specific proportions in which the factors are combined is determined by their

relative prices. Both inputs - normally, capital and labor - and output are expressed in the physical terms appropriate to each. Constant values are preferred as proxies for physical quanta; alternatively physical inputs can be expressed in index number terms, measured from some base period.

There are three basic production function forms:

a) The Leontief production function, with factors of production assumed to be used in fixed proportions, underlies the input-output table currently used.

b) The Cobb-Douglas production function displays greater flexibility by allowing for the substitution of one factor for another as relative prices change.

c) The third most general production function is the constant elasticity of substitution (CES). It establishes a relationship between capital, K, and labor, L, on the one hand, and output, P, on the other which is fixed for a given industry but can vary among industries.

Elasticity of substitution, σ, which is a function of these input/output variables, is independent of the units in which factors and products are measured and is symmetrical between factors; it is positive for all normal cases and can vary from zero to infinity, according to the ease with which one factor can be substituted for the other in production. Essentially, it is the ratio of rate of change in K, capital, to the rate of change in L, labor.

A negative coefficient is rejected as contrary to theory. The Leontief production function has a zero elasticity coefficient with its fixity of proportions among productive factors. The elasticity coefficient for a Cobb-Douglas production function is always equal to one. The CES production function has a constant elasticity coefficient for each industry which may vary among industries. Most substitution coefficients range between zero and two to three in practice, implying some constraint on the feasibility of substituting one factor for another. The range of coefficients appropriate for this analysis and for the selection of key processes is arbitrarily determined, based on judgment rather than any objective criteria. Other coefficients which measure economies of scale and efficiency are disregarded.

The production function approach does not focus on processes, but rather on the way in which productive factors are combined. It distinguishes between capital and labor, but all capital and all labor are

homogeneous within their respective classes. Production functions can be modified to allow for more than two productive factors, which in principle would be necessary to evaluate the degradation effects of a terrorist attack against specific key processes in producing a widespread disruption of production. In particular, it would be necessary to develop data on the elasticity of substitution at a sub-tier below capital, in which elements of production were addressed in each industry at the individual process level, in order to identify key processes. An implementation of this methodology must await the development of this data base.

A brief overview was also made[17] of the potential vulnerability of national financial institutions to terrorist attack. These include (in order of their total financial assets in 1965) commercial banks, life insurance companies, savings and loan associations, private pension funds, Federal Reserve banks, investment companies, Federal pension funds, and property insurance companies. But their relative assets are not an adequate measure of either their vulnerability to terrorist attack or their importance to the economy.

Vulnerability will be affected by the ubiquity and degree of exposure of the institution; and the greater the degree of exposure, the greater is its susceptibility to terrorist attack. On the other hand, the spread of an institution may imply that any single unit would be less important to the operation of the economy. A terrorist attack against it would have greater symbolic significance than economic effect. Other establishments of the institution could readily fill the gap created by the destruction of a single unit. On the other hand, a single unit of, say, a commercial bank may be very important to a given locality not only for the specific financial support a bank may provide a community but also because of psychological intangibles. The percentages which focus on the net assets of classes of financial institutions, provide no information as the volume or numbers of transactions completed between the institutions and those who borrow or lend with them. Thus, it does not tell us how those transactions affect the level of economic activity of sectors affected by the institutions.

The processes of finance are contained in a series of transactions which are manifest in a galaxy of financial instruments, book entries, and

personal relationships. There is a great variety among such institutions and transactions. Enormous amounts of finance involve the rendering of services, and are predicated on "promise to pay." This is unlike industry and manufacturing where inputs are corporeal, the value-added is the result of materials and labor inputs, the output is measurable, storable, and well defined. Numerous other differences arise as well.

While the relative value of the assets of each institution may broadly sketch the problem, more detailed analysis is required to ascertain the nodes of vulnerability of each of the classes of institutions enumerated. The development of flow charts for financial institutions as an aid in identifying nodes of vulnerability may have merit. In general, with increased computerization of the record keeping function in business, including financial institutions, terrorist attacks centered on them would be highly disruptive.

Two developments in the technology of banking are significant not only because they facilitate the handling of banking data and the transfer of funds, but also because they afford vulnerable nodes that, if attacked by terrorists, could adversely affect the conduct of banking. The first is the Electronic Funds Transfers (EFT) which at present service about 4,500 out of 14,000 commercial banks. The second is Distributed Data Processing (DDP) for recording accounts of customers with banks, manned by local operators. Moves are in process to further decentralize the DDP function. One objective in this computerization process of commercial banking of importance to civil defense is to build a redundancy into the system so that if some part of it is immobilized, the balance can carry on without impediment.

Another aspect of the banking system of importance to maintaining operations in the face of terrorist attacks involves the relationship between the Federal Reserve Banks and major commercial banks. There is provision for major commercial banks located in different parts of the country to assume central banking functions legally relegated to the Federal Reserve Banks in case of an attack against the latter. This appears feasible in that in other countries central banking functions are often performed by banks that also conduct a commercial business. Along with these regional banks that would assume central banking functions, some institutions are designated "cash agent banks." Their purpose is to

facilitate the flow of funds through the financial system and to provide the cash required by the community in the conduct of its business.

Hence, there is within the total banking system an emergency operation plan designed to permit the continued operation of the system even with the loss of specific functional nodes.

Potential Consequences of Nuclear Terrorism

It is always hazardous to speculate on the probable consequences of a major change in the level of threats to society. However, some responses to nuclear terrorism are reasonably predictable. To the extent that such projections can be made, they should be included in any assessment of the impact on civil preparedness policies and options.

Historically, successful new techniques of terrorism have been rapidly emulated by other groups. Success would be required not just in the technical execution of the act itself, but in the ultimate objective of intimidating target populations and coercing their responsive governments to their political will. Thus, a successful first event would immediately unleash a rapid succession of imitators. These might likely include the original perpetrators, whose operational capability would presumably have remained intact and whose technical and motivational capability would be high. At the other extreme would be the psychopaths having no credibility if the source of the threat were known, but requiring response at the time. The seriousness of the potential consequences will make it impossible for authorities not to respond to the threat, even though statistically most of them will turn out to be hoaxes. The major disruptions to society resulting from these hoaxes will achieve many of the terrorist objectives without the onus of mass deaths. The appeal will be irresistible once credibility is established.

Dr. Robert Kupperman has pointed out[21] another probable consequence of successful nuclear terrorism: there is likely to be an immediate hysteria which will grip the country. People will feel individually threatened and left unprotected by the government. The situation will be brought under control only if the government takes prompt, firm and effective action, rather than looking impotent by uncertainty in policy and confusion in its response. Such action requires careful planning and exercises both for the management of the event and for post-event recovery.

Increased attention must be given to procedures to be followed when a threat is received, to negotiating policies, and to the detail of public information to be released. Response planning will be required for handling casualties, providing food and shelter to the survivors, and initiating decontamination procedures. Problems in restoration and normalization will be less time-urgent, but will nevertheless lead to adverse public reaction if poorly handled.

Another likely consequence will be an immediate implementation of all feasible techniques to improve security at nuclear facilities which are thought to be the source of the materials used, or which could possibly be the source for other terrorists. This would include both physical security, such as the use of Army forces around nuclear power plants or weapon facilities, and technological improvements. These latter are of many forms: intrusion sensors on facilities, lock systems for weapons which would deny their unauthorized use even if stolen, and technologies for identifying the source of a nuclear explosive. At the same time there will be pressure to increase international cooperation in the physical control and monitoring of possible sources of weapon material. These actions to control and monitor nuclear facilities will likely be accompanied by a wave of antitechnology sentiment.

Lastly, there may be basic changes in national attitude which will lead to basic policy changes. Our present policy against making any but superficial concessions in terrorist negotiations, in recognition of the adverse impact such concessions have in controlling future terrorism, may fall in the face of the immediate threat. Our present national emphasis on individual rights may give way to a general crackdown on all dissidents, and a general increase in authoritarianism. If it is perceived that sufficient international cooperation is not being received from nations thought to be the source of the terrorists or their weapon material, direct military actions against such nations may result. There have been numerous examples (Ireland-Northern Ireland, Lebanon-Israel, etc.) of para-military actions in recent years in which the level of threat has been much lower than that of massive nuclear distruction.

The consequences so far discussed have been the result of the phycho-logical impact on potential victims of such terrorism. Although these reactions will be of dominant importance, particularly when attacks are

directed in a random manner against population centers, a carefully planned attack against a sensitive industry or other facility vital to public survival could have massive direct consequences. This would be particularly true if it were part of a series of such events, perhaps including more mundane yet effective forms of industrial sabotage. The psychological impact resulting in a perception of national helplessness, in combination with significant physical damage to production and the life-support infrastructure, could lead the nation in one of two diametrically opposite directions. It might either motivate the nation to an exceptional effort backed by a firm determination to overcome the threat, or could perhaps paralyze it into helpless inaction and division. If the scenario were one leading to general nuclear war, the latter course would make effective mobilization impossible.

VI CURRENT POLICY AND PLANNING

Policy

This study has been unable to identify any policy document specifically pertaining to nuclear terrorism which has general acceptance at Federal, state, and local levels. It is evident that, at the moment, national policy will be a combination of policy pertaining to conventional terrorism and nuclear threat emergency preparedness. This raises a question whether this mix of policies will be consistent and adequate as it may come to be applied to a nuclear terrorist event.

Current national policy for conventional terrorism includes the following:

- No substantative concessions to terrorists while they are holding hostages.
- No ransom payments for kidnapped government officials.
- No interference with private ransom payments.
- Strong support for international agreements to control terrorism and apprehend and convict terrorists, under State Department jurisdiction.
- Terrorist acts are common crimes, devoid of any mitigation deriving from their political motivation, and hence under the jurisdiction of the Justice Department.

Although there appears to be no commonly agreed-upon nuclear terrorism policy, a draft report[22] by the Executive Committee for Combatting Terrorism, in addressing international policy, states:

> "While the United States has not formally adopted a detailed policy on terrorism, the Department of State in its contacts with other governments has consistently set forth a list of seven guidelines that are said to informally summarize U.S. attitude toward international terrorism.
>
> - We condemn all terrorist actions as criminal and intolerable whatever their motivation.
> - We take all lawful measures to prevent terrorist acts and to bring to justice those who commit them.
> - We avoid concessions to terrorist blackmail because to grant concessions only invites further demands.
> - We look to the host government when Americans are abducted overseas to exercise its responsibility under international law to protect all persons within its territories, including the safe release of hostages.

- We maintain close and continuous contact with the host government during terrorist incidents, supporting the host government with all practical intelligence and technical services, but we offer no advice on how to respond to specific terrorist demands.
- We understand the extreme difficulty of the decisions governments are often called upon to make. For example, how as a practical operational matter to reconcile the objectives of saving the lives of the hostages and making sure that the terrorists can gain no benefit from their lawless action.
- International cooperation to combat terrorism remains essential since all governments, regardless of structure or philosophy, are vulnerable. We intend to pursue all avenues to strengthen such cooperation."

National policies concerning emergency preparedness and response must cover a very broad range of potential disasters, and are thus more heterogenous and less consistent.

- In considering the potential for strategic nuclear war, our national policy of mutual assured destruction has been somewhat modified by PD41 to reduce the possibility that the Soviets could coerce us.
- State and local authorities have primary responsibility for the health and safety of citizens, with Federal assistance coming through many channels.
- The basic response to a massive threat is evacuation.
- Federal disaster response planning is to be centralized in FEMA.
- Beyond specific assistance available through current Federal laws, the impact of disasters will be borne by individuals and institutions of the private sector.

Federal Response Planning

In response to the Lod Airport and Munich Olympic massacres in 1972, the Cabinet Committee to Combat Terrorism was formed, meeting only once before its formal dissolution in 1977. However, its Working Group to Combat Terrorism has met regularly and continues to be the interagency (see Table 1) group for planning coordination at the Federal level, working through task forces addressing contingency planning and crisis management, prevention, prediction, and security policy. The Working Group is under an Executive Committee for Combatting Terrorism, chaired by Ambassador Quainton, which itself is under the general guidance of the Special Coordination Committee of the National Security Council. This structure is perceived as an "antiterrorism program concept based on the organization and coordination of existing Federal responsibilities and capabilities within a clearly defined command and control structure linking, when necessary, field operations with the Executive Office of the President."[22]

Table 1: Membership of the Working Group to Combat Terrorism

- Agency for International Development
- Arms Control and Disarmament Agency
- Central Intelligence Agency
- Defense Intelligence Agency
- Department of the Army
- Department of Commerce
- Department of Energy
- Department of Justice
- Department of State
- Department of Transportation
- Department of Treasury
- Federal Aviation Administration
- Federal Bureau of Investigation
- Federal Preparedness Agency
- Immigration and Naturalization Service
- Joint Chiefs of Staff
- Law Enforcement Assistance Administration
- Metropolitan Police Department
- National Security Agency
- Nuclear Regulatory Commission
- Office of Management and Budget
- Office of the Secretary of Defense
- United States Coast Guard
- United States Customs Service
- United States Mission to the United Nations
- United States Postal Service
- United States Secret Service

The Executive Committee for Combatting Terrorism (ECCT), chaired by a representative of the State Department and having a representative of the Department of Justice as deputy chairman, might thus be considered from its membership to be the focal point not only for planning but also for operational response. Although the ECCT would seem to have broad responsibilities in both the event phase as well as the mitigation phase, Ambassador Quainton stated [23] that the ECCT has not been given the mitigation charter, and does not seek it. Terrorism in the forms encountered up to this point have not required any mitigation planning, generally being within the capabilities of local groups. He assumes that the act of duration of a nuclear terrorist event would be managed in the same manner as the more extreme cases of conventional terrorism: that is, it would be directly handled by the President in consultation with several of his closest Cabinet advisors. The mitigation phase would be left to FEMA.

In effect, at the Federal level, there are two lead agencies for terrorism.[6] The Department of Justice has jurisdiction over activities within the U.S. and U.S.-controlled areas, while the State Department has the lead in terrorist events taking place outside the U.S. but in which significant U.S. interests are involved. During the act of duration itself, when negotiations seeking release of hostages are of primary importance, Justice is the lead agency, using the FBI for operations in the field. In the case of nuclear terrorism it is clear that DOE and DOD will

necessarily have a major involvement. At the present time there are at least three agreements defining the authorities and responsibilities of these three agencies: a DOD/DOE agreement of 1 March 1977, DOE/FBI memorandum of understanding of June 1976 dealing with response to accidents or incidents involving nuclear material, and the Attorney General's letter to the Secretary of Defense on assistance to Federal agencies in combatting terrorism dated November 10, 1972.

However, it is presently intended that these bilateral agreements will be subsumed into a new multilateral agreement currently being circulated in draft.[24] In it, operational policy is stated as follows:

> In the event of a Nuclear Threat Incident involving an Improvised Nuclear Device (IND): the Federal Bureau of Investigation is responsible, as set forth in Section 221.b. of the Atomic Energy Act, as amended, for investigating all alleged or suspected criminal violations of that Act. The FBI has primary jurisdiction where a question of the violation of Federal law exists, and, where appropriate, will coordinate the utilization of available resources in the interest of public health and safety.
>
> The Department of Energy, and the Department of Defense will provide assistance and support to the FBI as listed in Section V of this agreement.

The several areas of responsibility, detailed in the draft MOU, can be summarized.

- The FBI will act as the Federal agency in charge at the scene of an emergency involving an IND and assume jurisdiction over all field organizations.
- DOE will provide scientific and technical assistance in threat assessment, search, deactivation, and cleanup.
- DOD will provide explosive ordnance disposal, technical and operational assistance.
- All press releases will be coordinated by the FBI with DOE and DOD.
- In the event of a major emergency or disaster, DOE will assist in post-incident cleanup in coordination with the DOD and various civilian agencies.

In summary, these several agreements of the FBI, DOE, and DOD represent the most complete and specific planning found amongst potentially involved Federal agencies. The use of these plans in a continuing series of real incidents and planned exercises lends credibility to their timely application in a serious nuclear terrorist incident.

The responsibilities of the Nuclear Regulatory Commission should the nuclear terrorist threat involve reactors or reactor materials are not as well defined or exercised, although the ERDA/NRC MOU of March 8, 1977 has made a start. The applicable Executive Order,[11] covering all forms of nuclear emergencies, addresses issues primarily relevant to general nuclear war. However, several sections are particularly relevant to terrorist activities.

- DOE shall " . . . participate in the conduct, direction, or coordination of search and recovery operations for nuclear materials, weapons or devices; assist in the identification and deactivation of improvised nuclear devices; and render advice on radiation and damage probabilities in the event of the detonation of an improvised nuclear device."
- DOE shall " . . . maintain in coordination with the NRC general liasion with the states concerning DOE health and safety operations to ensure that these operations are effectively maintained . . ."
- NRC shall " . . . implement contingency plans developed in consultation and coordination with (DOE) and other departments and agencies as appropriate, for dealing with threats, thefts, and sabotage relating to special nuclear materials, high-level radioactive wastes, and nuclear facilities . . . and participate in the execution of the plans where necessary to protect the public health and safety . . ."
- NRC shall " . . . maintain, in consultation with other cognizant Federal agencies, general liasion with the several States concerning the Agreement States materials licensing program and the radiological incident emergency planning program . . ."

The words "consultation" and "coordination" are useful in directing what agencies should be involved in a particular type of incident, but are totally inadequate in establishing their detailed interactional responsibilities necessary for smooth emergency operations. MOU's are required amongst NRC, DOE, FBI, and FEMA comparable to reference 24.

Other attempts to reach firm policy and precedural agreements amongst responsible Federal agencies who would be involved in the various phases of nuclear terrorism have been less successful. The Federal Preparedness Agency has drafted a proposed guidance for Federal agency response to disruptive terrorism.[2] It states that the "preparedness effort should include provisions to:

- deal with the incident itself as a criminal act,
- provide assistance to alleviate suffering to persons,

- restore the disrupted processes and damaged property to normal levels; and,
- reestablish or maintain the credibility of government as the protector of the population."

The proposal lays the groundwork for major interagency studies in civil system vulverability analysis, analysis of the production and economic consequences, and an assessment of current preparedness planning through an evaluation of individual agency response to a tailored set of scenarios.

The "Federal Response Plan for Peacetime Nuclear Emergencies" (FRPPNE)[25] is another unconsummated document proposing an organizational structure under which Federal agencies would develop a consistent set of plans for the response to major nuclear emergencies. Not only was it to identify responsibilities for implementing and coordinating Federal agency response, but also provide the basis for compatibility between Federal and state plans. The plan proposes four categories of peacetime nuclear emergencies and summarizes the current status of planning for each.

Category I: "A nuclear incident which is limited in that its effects are minor and localized. Category I incidents are manageable under existing arrangements with resources readily available, and without recourse to extraordinary measures." Considerable planning has already been accomplished by the agencies having primary responsibility (FBI, DOE, DOD), and somewhat less completely by NRC.

Category II: "An incident which has the potential of producing a nuclear detonation and/or widespread dispersal of radioactive contamination." Planning has been limited primarily to preventing access to materials, detection of loss, recovery, and prosecution of those involved. The DOD has weapon theft and accidental launch response plans.

Category III: "An occurrence in which . . . there is a nuclear detonation and/or widespread dispersal of radioactive contamination." Limited response planning has been accomplished by some Federal agencies, primarily directed towards support of state and local operations.

Category IV: "The post-Category III environment during which long-range recovery and rehabilitation are effected." No planning was identified.

In effect the FRPPNE designates two levels of nuclear incidents. Category I incidents have consequences of only minor importance, such that prevention and management of the event itself are the critical actions, for which current agency planning has made a credible start. Categories II through IV are really three phases of a single category in which there are serious consequences. Event management is reasonably compatible with

Category I plans, but mitigation planning for all three phases (including before the event takes place) is notably missing. The FRPPNE has, to this point, been unsuccessful in stimulating the required planning response by other agencies.

In summary, a credible start has been made in Federal response planning for a nuclear terrorist emergency, but gaps in this planning would probably lead to a perceived chaotic response should such an event occur today.

- Current policy in dealing with terrorists should be reviewed in view of the potential seriousness of the consequences of nuclear terrorism.
- The senior government group should be identified that will manage a serious incident, which will advise the President and through which he will implement his decisions.
- The positions of FEMA and NRC within this advisory and operational group should be firmly established.
- A policy concerning information release to the public and the corresponding public safety precautions to be implemented should be developed.

State Response Planning

The National Council of Governors has recently completed a survey of state emergency response planning.[26] In it is included a statement of government roles and responsibilities at three levels.[27]

- Local Government: "States recognize local government as having the first line of official public responsibility in the preparation for and response to most emergencies." Local governments should utilize local resources to the feasible limit, appeal to the state when local resources are inadequate, and provide mutual assistance to other local governments as the need dictates.
- State Government: "The States' role is to develop and maintain a comprehensive program of emergency management activities that supplements, facilitates, and provides leadership when needed to local efforts before, during, and after emergencies." Thus a state should expedite state support to local governments, arrange for mutual interstate support, and facilitate acquisition of Federal assistance as required."
- Federal Government: "When states have insufficient resources to manage all prevention and mitigation, preparedness, response, or long-term recovery services themselves, the Federal government should provide services that are responsive to all types of emergencies and disasters."

Historically, emergencies to which state governments have been called upon to respond have been primarily natural disasters. A survey[26] covering

the period 1973-77 showed 1170 such events, while over the same period there were only 291 man-caused events. But in the first six months of 1978 there were twice as many man-caused as natural hazard emergencies. Thus, states will have to reassess their response planning to include this class of event, the various types of which continue to expand rapidly.

Thus, it appears that states require both an organizational and a planning structure.

- A centralized focus of responsibility for all emergency operations is required to cope with events which are increasing in number of types and in frequency. Through experience and use both the governor and the supporting state agencies, as well as citizens, will look to this organization to provide a coherent and timely response.
- Specific plans need to be developed for the more critical classes of emergencies which are compatible with the above organizations expected to implement them. Of course, there cannot be a plan for every type, but a terrorist nuclear explosion is of such importance to be of high priority.

The survey[26] indicates that this central focus of responsibility generally exists in each state, but there is no common agreement as to its best organizational location. In its evaluation of the effectiveness of various management channels, it was generally felt that preparedness and response was best handled by military or police forces, while mitigation and recovery is best managed by civil program and policy offices. This perception at the state level is in consonance with current planning at the Federal level, in which the FBI, DOE, and DOD would manage the nuclear terrorist event, while FEMA is looked to for coordinating the mitigation and recovery response.

Specific planning for nuclear emergencies exists in only a few states, with the California plan[28] the furthest developed. Its basic concept has a task force, chaired by the FBI, with members of Federal, state, and local agencies as the controlling and coordinating organization. If the threat is actually carried out, local government in coordination with the task force will assume the lead operational role. Its apparent operational concept is that all participating organizations will perform their normal functions, while the task force will act as coordination and information exchange center. This begs the question of the channels through which time-urgent decisions will be made. The plan states that "Command decisions

will be made by appropriate members of the task force, with regard for the discharge of their respective responsibilities, as the situation develops." The conflicting objectives of the various participating agencies, in addition to the obvious cases of overlapping jurisdictional responsibilities, lays the groundwork for confusion and contradiction.

- The plan appears not yet to have been approved at any of the necessary Federal, state, or local levels.
- It appears to propose committee management of a time-urgent task.
- The Governor and his immediate staff are not included in the direct management, as will clearly be required in any serious event.
- It does not resolve the basic dichotomy between "bottom up" responsibility for the health and welfare of the population with "top down" cognizance over all things nuclear.
- It suggests total command will come from an ad hoc regional EOC, failing to acknowledge that basic decisions in serious cases will be made by the Governor and in Washington.
- It contains no common policy on public relations and information release channels beyond " . . . agencies will be responsible for preparing releases pertaining to their activities."
- It does not establish policy or procedures for periodic exercises using scenarios to involve the broad range of potential participating agencies.

Local Preparedness Planning

The main thrust of local preparedness planning and practice obviously centers around the daily events of accidents involving a relatively small number of people, generally localized fires, and utility crises from equipment breakdown and other outages. State assistance (and sometimes Federal) is generally required for more extensive emergencies, whether natural or man-made. Forest fires, heavy snowstorms, hurricanes, widespread food or fuel shortages, and earthquakes are typical examples of this type.

Mr. Frank Brittell, recently retired from a senior position in the Los Angeles Police Department (LAPD) discussed[29] policy and procedural problems that arose in a case of this type. During a major brush fire that swept through a section of the Bel Air district of Los Angeles, the LAPD required the evacuation of all residents of the threatened area. A significant number of residents who either avoided evacuation or subsequently returned clandestinely were able to save their homes by individual firefighting action. The LAPD was subsequently faced with numerous lawsuits

by some who lost their homes, claiming they could have been saved had they not been required to evacuate. The subsequent policy decision by the LAPD not to require evacuation even under such threatening circumstances may not be in the best interest of citizens in other cases.

Mr. Brittell made some general observations regarding the capabilities of local authorities to handle larger emergencies.

- Federal/state/local responsibilities are so jumbled as to be a potential source of major difficulties.
- In a crisis, public support depends on visible, dynamic and effective action by the authorities. Mere containment of the threat is not enough.
- Training and exercises are necessary for an effective disaster planning capability.

At the other extreme of civil emergency - strategic nuclear war - there has long been preparedness planning reaching from the Federal level, down through the states, to regional and local authorities. Local emergency planning must close the gap between this ultimate disaster and the smaller emergencies within current capabilities of local authorities. A terrorist nuclear explosion would fall into this intermediate range for which emergency planning is notably lacking.

- Nuclear weapon phenomonology is inadequately defined.
- There is a clear incompatibility between the authority of Federal regulatory and law enforcement agencies in cases involving the Atomic Energy Act with that of local authorities for the health and safety of its citizens.
- There is no organizational plan by which all responsible and cooperating organizations can take timely action in an emergency.
- There is no operational plan by which local authorities can participate in assessing the credibility of the nuclear threat, implement city-wide protective procedures if appropriate, and immediately implement recovery and reconstitution processes if necessary.

The Three Mile Island (TMI) nuclear reactor accident on March 28, 1979 has brought out some of the policy, organizational, and procedural problems which are likely to be encountered in a terrorist nuclear explosion:[30-32] It was a prolonged crisis of about ten days having a sequence of events initiated by the failure of a pump. It is generally agreed that the sequence of problems which followed were caused by a series of human and equipment failures, perhaps exacerbated by inadequate rules and procedures. The threat to the public was twofold:

- Sporadic, partly uncontrolled venting of relatively small quantities of radioactive gas, potentially having long-term medical implications when a large population group is exposed.
- The fear, starting the fourth day, of an explosive rupture of the reactor which would create an immediate hazard to populations up to twenty miles downwind.

Management issues in the TMI event were rather similar to what might be anticipated in managing a terrorist nuclear event. There were both organizational issues in the management of the reactor problem itself, and issues of managing preparations and decisions pertaining to mitigation and public safety. These issues were of concern at many levels of Federal, state and local government.

Initially the operational personnel of the plant managed the efforts to bring the reactor under control, with NRC personnel serving in an advisory and monitorial capacity. The Chief of Reactor Operations, NRC, effectively took control of the plant operations by the morning of the fourth day, using a hastily-assembled operations center just outside the plant. On the fifth day of the crisis President and Mrs. Carter, accompanied by Governor Thornburgh, visited the TMI plant control room for a first hand inspection and to quiet public fears. Eventually the reactor was cooled to a safe temperature without a major radiation discharge. During the operations, however, radioactive materials (water and gases) were released unintentionally and intentionally from time to time in amounts apparently within safe levels for short time exposures under current criteria.

Thus the event was really managed in the field by the NRC, strongly influenced by public opinion fed by heavy press coverage, with a direct feed of information to the Chairman of the NRC, and thus to Jack Watson, designated by the President as the communications link to him. Noticeably absent from this management chain were any of the Federal, state or local authorities responsible for mitigation planning.

There were a large number of such agencies primarily concerned with the safety of the local citizens. These included DCPA, FPA, FDAA, and EPA of the Federal government, the Pennsylvania Emergency Management Agency, Department of Health, Department of Transportation, and the Department of Environmental Resources, and particularly the Governor himself, plus the local mayors and county governing bodies. For these agencies the TMI

emergency threatened the safety and welfare of the local citizens in a geographical area that could extend several hundred miles down wind for a major release of radioactivity.

Most of the Federal agencies concerned have regional action centers in the Philadelphia area that responded initially. However, activity rapidly migrated to the three major centers of power located in Washington, D. C., Harrisburg, Pa., and on site. In Washington, DCPA, FDAA, NRC, FDA, EPA, and FPA were the major agencies involved. Initially, FDAA was the Federal agency in charge, and NRC became the lead technical agency about the time Harold Denton took charge at the TMI plant. The role of the Washington Operations office of DCPA was one of gathering information and monitoring the event. This information was passed to the White House in a daily meeting of Presidential Assistant Jack Watson with representatives of DCPA, FDAA, NRC, and FPA. In addition to furnishing information to the White House, the DCPA sent personnel to Harrisburg and to the local governments. These personnel were used at the local level primarily to augment staffs responsible for evacuation planning. The DCPA also provided personnel in conjunction with EPA and the state health department for off site radioactivity monitoring.

Thus, almost by default, Harrisburg became the center for mitigation planning. The Harrisburg emergency operations center (EOC) was under the control of Governor Richard Thornburgh and Lt. Governor William W. Scranton III, supported by the state agencies previously mentioned as well as representatives of the Federal agencies. Although the state operation was the closest to having overall control, the Governor lacked influence over on-site operational decisions being made by NRC at the plant. Even worse, information as to what was happening at the plant was relayed to him second-hand from Chairman Hendrie in Washington, and the Governor had to guess the probable course of future events using his EOC advisors. There were several occasions, such as an intentional release of radioactivity, when advanced information to the Harrisburg EOC would have been extremely valuable.

The local governments (cities and counties) had the primary responsibility for planning the evacuation of the people. In 36 hours plans were ready for 5 mile and 10 mile radii evacuations. But as a result of

the above radioactivity release a 20 mile plan requirement came out before these were put into effect. The evacuation planning exercise went very smoothly, although relatively small numbers of people were involved. However, under other circumstances, such as a faster moving incident when there was inadequate time for planning or if there were an extensive mitigation problem, additional deficiencies might have come to light.

From the point of view of FEMA's concern for mitigation planning the following observations are made.

- Event management and mitigation planning cannot be carried out by separate groups, even though the agency having primary responsibility can change as the event unfolds.
- State and local authorities must be included in basic decisions, but particularly those concerned with hazard evaluation.
- The press cannot be used as the primary channel for gathering information and disseminating it amongst government agencies. However, it is advisable to couple the press as closely as possible to the flow of events.
- Emergency planning has many unresolved policy issues as, for example, legal liability for damage to people and property from a reactor explosion when it was then under direct NRC control.
- Much additional planning for emergency evacuation is required at all government levels, for all magnitudes of severity, and for many locations.
- The real problems of a major evacuation were not exposed by TMI.
- The probable structure by which the President might manage a more serious event is no clearer as a result of TMI.

VII. RESPONSE OPTIONS AND COMPATIBILITY WITH CURRENT PLANNING

The DOE states[10] that nuclear threats or other nuclear emergencies judged potentially serious enough to require a response of their NEST occur with an average frequency of once a month. Although it is evident that the credibility of each threat is considered on a case-by-case basis, the response has generally been very low-key. The threats have been pursued as a matter of great urgency but as quietly as possible to avoid arousing public concern. Since the threats have usually been either hoaxes or very limited in the extent of the threat to life, such a response has worked well.

A case could also be made for a different response option--one in which a major effort was made to keep the public informed in a timely way and in some detail as the event unfolds. There are some rather obvious tradeoffs between these options.

- Current practice avoids unnecessary emotional and economic disruption to large groups of people in their daily activities.
- It avoids pre-conditioning people into assuming all such threats are hoaxes, which would seriously erode public response should a real threat be executed.
- It avoids the greatly increased numbers of such threats which would logically follow from the wide publicity, were it given to the current events.

On the other hand, if a credible, serious threat must eventually be anticipated:

- The required response to threats--assumed to be hoaxes at least the first few times--will provide experience and training, and force more adequate planning, for the real event.
- Public confidence is maintained when people feel that officials are providing timely, accurate information.
- Response training will be generally applicable to a broader range of civil emergencies.

Organizational options for nuclear emergency response in principle could cover a very broad range. But any of them must adhere to the practice of using a common set of response groups for all emergencies, although structured in an appropriate way for different type of threat. The study[26] for the National Governors' Association makes the specific point.

"Further, Governors who are experienced with disaster preparedness state that because the variety of hazards is great and growing, as are

response costs, yet personnel, equipment, and dollars are scarcer, integrated emergency management for all risks (attack, man-made, and natural) should make the most efficient use of available resources." The key will thus be to maintain an organizational structure having the required flexibility to respond to this variety of hazards.

The basic concept of response planning for all except the threat of strategic nuclear war is a "bottom up" request for increasing assistance. Man-made emergencies, typified by the TMI nuclear reactor accident or a chemical spill, are generally first brought to the attention of local authorities who respond with police or medical assets under their control. Regional, state, and national assets in turn can be brought to bear at the request of the lower organizational level and with the concurrence of the more senior level that the currently available assets are either exhausted or in danger of it.

Such a "bottom-up" approach will not be appropriate for major nuclear terrorist emergencies.

- It is too slow for responding to a fast-moving, major threat.
- It fails to recognize the basic Federal jurisdiction over nuclear affairs.
- It fails to recognize that a Governor and the President will naturally become directly involved in a major threat and any subsequent disaster.

The level of emergency for which such a response is necessary can be understood from the TMI incident. In it, Governor Thornburgh became directly involved in mitigation planning on a continuing basis. On the other hand, the President did not take direct control of the management of the event, even though he kept himself closely informed as events unfolded through an ad hoc Federal organizational structure, and made the trip to the field to help allay public concern. Any nuclear event of significantly greater severity, of which a credible terrorist nuclear threat is typical, would very likely result in direct Presidential management.

Thus the organizational option required for effective management of a nuclear threat to perhaps a hundred thousand lives must place the President, the affected governor, and the mayor each in direct, effective operational control of the assets at his respective level. At the Federal level the information flow and decision making channels must be established between the President and the responsible agencies through his

immediate White House staff. Similarly, governors and mayors must develop, if not already available, the organizational structure through which they will work. Jurisdictional overlap can never be totally eliminated by common agreement before the fact. As actual events unfold in a way quite differently from any pre-planned scenario, only such senior leadership can make timely and effective decisions.

In additon to these organizational issues in response planning, there are several response options available for physical protection when some degree of warning time is available. U.S. policy for civil defense in the event of strategic nuclear war has centered around either evacuation from targeted or population centers, or protection in place. Combinations of these two techniques are clearly feasible. Planning emphasis has changed over the years.

- Evacuation was favored in the 50's when the threat was relatively small in number of weapons, and warning time relatively long because of bomber flight time.
- With the advent of more numerous, missile delivered weapons, sheltering of urban populations within the cities seemed the only practical method.
- In this decade our national policy has tended to de-emphasize the importance of civil defense. At the same time our essential equivalence with the Soviets has made a period of degenerating relations a logical precursor of nuclear war. Thus, our current planning for the crisis relocation of threatened populations in times of tension becomes feasible.

Without discussing further the appropriateness of current evacuation planning in general nuclear war, it is the most feasible technique for the terrorist threat.

- A shelter program would not be cost effective against the blast threat. Shelters would have to be built for essentially all urban populations, while the quantitative payoff in number of people saved would be small.
- The total number of people involved and the distances to which they would have to be evacuated are comparatively modest.
- There is likely to be time for evacuation, since an unwarned detonation is not coercive.
- People will be naturally inclined to evacuate.
- It will be feasible to support evacuated people, since the majority of people on which support depends will not themselves be threatened.

Planning for such evacuation is generally compatible with that for strategic nuclear emergencies, although details of support at displaced locations

and the distances involved will differ. Finally, if a series of terrorist nuclear threats does ensue in the coming years, as this study suggests, the evacuations will reinforce the requirements for planning, particularly at the city-mayoral level, and at the same time provide useful, illustrative experience.

Current Federal planning for providing aid to state and local authorities for recovery from natural and man-made disasters is decentralized but extensive. Compilations of such assistance are available in OMB's "Catalog of Federal Domestic Assistance" and the recent study for the National Governors' Association.[33] These plans for response to a "bottom-up" request for assistance in recovery from such disasters are compatible with the corresponding requirements subsequent to a terrorist nuclear explosion as far as they go. However, there is a unique requirement for equipment and trained personnel for monitoring extensive alpha-particle contamination, which may follow an only partially successful detonation, to complement the conventional civil defense radiological survey instruments. In addition, requirements for similar chemical and biological threat survey and monitoring instrumentation can be anticipated for the more distant future.

Initial thoughts of industrial hardening have reached an impass primarily arising from regulatory and cost demands. It is obvious that vulnerable elements of industry and critical support services of the infrastructure can be given increased protection either by physical protection means or by various techniques for including hardening in their initial design, or alternatively by increased redundancy in the total system. Studies of the effectiveness of such protection or hardening techniques have been opposed by both industry and Federal agencies to which they respond.[3,25] Industries are reluctant to generate the detailed data required for the studies since it will expose them to public criticism should failures occur, and would highlight their vulnerable points for terrorist attacks. Federal agencies are generally concerned that all such increased costs will be passed on to the ultimate consumer, with no immediately obvious compensating advantages. Considering the limited threat of nuclear terrorism, that very damaging industrial attacks are feasible using conventional explosives, and that large numbers of people are the most likely targets of nuclear terrorism, industrial harding for this purpose alone does not appear feasible. However, pilot studies, if

they could be carried through to completion, would be useful to confirm this judgment. Any such measures which can be rationalized on the basis of preparedness for nuclear war or widespread natural disasters would naturally be effective in reducing vulnerability to terrorism.

The regulatory structure of our national laws continues to grow at a rapid rate. These weigh heavily in construction standards, working conditions, taxation, accounting, employment, finance and banking, transportation, polution, and so forth. We presume that these have been optimized in the cost/benefit tradeoff under current circumstances of national well-being. However, a new equilibrium point is likely to result from any perceived major change in our national state. Even though numerous illustrations could be made, the point is obvious. What is not as obvious is that these regulations can be relaxed quickly and to the required degree under the pressure of circumstances and when only a minority of the population is affected. Preplanning of such policy changes in the event of nuclear terrorism would have to be adaptable to a broad spectrum of scenarios, and this is impractical in detail. However, a limited set of pilot studies, rationalized under the larger threat of nuclear war, would initiate a principle amongst the regulatory agencies which would be beneficial in the event of nuclear terrorism.

In summary:

- Nuclear terrorism will require FEMA to extend its "bottom-up" response planning to small emergencies to meet the "top-down" planning of other Federal agencies in the contingency of general nuclear war.
- Strong, centralized leadership will be required at all levels of government.
- Further planning and exercises are necessary to establish the relationships between the many agencies involved.
- People will demand a rapid response to nuclear terrorism, adhering to principles that can be lucidly explained.
- Continuity of government will be threatened by nuclear terrorism only should citizens perceive government to be helpless and ineffective.
- The requirements for nuclear terrorist response planning are not inconsistent with response planning for other types of national emergencies.

VIII FINDINGS AND RECOMMENDATIONS

In the last decade the developed world has been exposed to an increasing level of terrorist activity, accompanied by a generally increasing level of violence associated with individual events. But as terrorism has become more commonplace, it has lost some of its coercive effect, with a potential increase in the appeal of nuclear threats, or a similar circumstance available through chemical or biological weapons. The starting point of this study has been that an adequate technology for any of these techniques of mass destruction can feasibly be assembled by a reasonably sophisticated and adequately funded terrorist group. Although the study has focused primarily on the detonation of a nuclear explosive in an urban environment, the majority of its conclusions are also generally applicable to the broad dissemination of hazardous quantities of radiological, chemical, or biological materials.

Nuclear terrorism has policy and management issues in common with both other forms of "conventional terrorism" on the one hand, and a very broad range of emergencies and disasters on the other. In the range of terrorism, it is at an extreme violence not yet experienced. Thus the current focus on management of the terrorist event itself must now be broadened to include mitigation and recovery planning from its serious consequences. However, within the range of disasters, the tens of thousands of potential casualties places it somewhere between the relatively frequent disasters involving hundreds and a general strategic nuclear holocaust involving tens of millions. An appropriate melding of event and mitigation management is clearly required.

A number of findings and recommendations have been drawn from this study. They fall generally into the several areas of policy, organization, planning, and technical issues.

1. The probability of nuclear terrorism, although it may not be high, is sufficient such that, in view of the potential seriousness of its consequences, careful planning for its management is required.

2. Should a serious event of nuclear terrorism occur, it is possible that it will constitute a surrogate action on behalf of a foreign national power. This could be in the form of technical assistance, materials,

money, or planning. It is less likely, but still feasible, that a nuclear weapon itself be provided. Such national support to a subnational group would very likely initiate a series of events which could be a part of a larger international struggle.

3. It is recommended that national policies appropriate to serious nuclear terrorism be developed and approved in advance of such an event. They must be available for immediate presentation to the public, along with a clear exposition of their rationality, without the lost time and damage to public confidence of internal governmental discussions.

4. It is recommended that options be developed for current regulatory policies in such fields as construction, transportation, banking, environment, and occupational health and safety reflecting a cost/benefit ratio which is commensurate with the anticipated crisis.

5. It is recommended that probable jurisdictional overlaps of responsibility at several levels of government be examined, with the objective of defining lead roles and decision-making channels, as well as identifying acceptable consultative and implementation groups.

6. The study suggests that evacuation is the only feasible and cost-effective protection policy which will be appropriate to nuclear terrorism. Plans will have to be tailored to specific scenarios. However, in unique instances in which the weapon location and yield are known with some precision, and where shelters are available, sheltering may be a preferable alternative for some groups of people.

7. It is recommended that policy alternatives for financial liability be established for responses to nuclear terrorism, whether caused by a hoax or an actual explosion.

8. Since public relations will become a vital element in any credible nuclear threat, it is recommended that an information release and media communications policy be established compatible with previously established policies.

9. The study finds that the public psychological reaction to nuclear terrorism will have an importance which far outweighs the physical impairment of the nation through loss of lives or facilities. Clearly stated policies which are rapidly and effectively implemented through the coherent actions of all branches of government will marshal public will and determination in the face of such adversity. Conversely, if public confidence

is lost through a failure to achieve these objectives, government institutions themselves may be placed in jeopardy.

10. The study finds that the seriousness of a credible nuclear terrorist threat is likely to result in the direct and continuing involvement of the President and the relevant governor and mayor, both in negotiating with the terrorist group and in recovery. Resources at each governmental level will be marshalled under that senior official.

11. Organizational plans currently in place at the Federal level for the management of terrorist events are incomplete for what will be required in nuclear terrorism. First, it is recommended that FEMA be fully involved during the span of duration when discussions with the terrorists are ongoing and alternative courses of action are being considered. Second, a group other than the Executive Committee for Combatting Terrorism and its Working Group to Combat Terrorism should be established to form the vital functional link between the President and the action agencies.

12. It is recommended that an MOU between the FBI and FEMA be developed and approved that will establish the interrelationship between the two agencies in nuclear terrorism, and particularly provide a smooth transition from terrorist negotiations to mitigation and recovery.

13. It is recommended that the centralization in FEMA of the responsibility for mitigation and recovery at the Federal level be implemented by a series of MOU's between FEMA and other agencies which will have to support and implement recovery processes.

14. The study finds that the planning and organizational requirements for nuclear terrorism mitigation are not inconsistent with the requirements for the broader range of disaster and emergency planning at all levels of government. However, there are unique requirements for some additonal specialized equipment and training.

15. It is recommended that nuclear emergency contingency plans be developed by all states, and that FEMA support the development of a model plan which can be modified to fit the needs of individual states. To the extent that such a model plan is followed by the states, it would facilitate a uniform mode of Federal-state interactions.

16. The study finds that the technology of locating hidden weapons in urban areas is extremely limited without some terrorist data as to its general location such that only a limited search area need be covered.

17. It is recommended that FEMA evaluate the feasibility of supporting, through its normal civil defense radiological monitoring channels, the provision of equipment and trained personnel to aid DOE in its weapon search mission, and alpha monitors and training for plutonium cleanup following weapon destruction. Bacteriological and chemical monitors should also be considered.

18. The study finds that low-yield nuclear weapon effects in urban areas differ significantly from free-field data, and recommends that further studies be made of such effects.

19. It is recommended that the results of the physical effects studies in #18 be used to aid in the development of a model guide for city response planning.

20. The study finds that industry is highly vulnerable to conventional terrorism using ordinary explosives, and perhaps to symbolic nuclear terrorism through the dissemination of radiological materials, but would not be a prime target for nuclear explosives.

21. Industrial hardening is not generally cost effective or otherwise feasible on the basis of apparent current national priorities. However, any such actions rationalized by survival in strategic war would be generally useful against nuclear explosive terrorism.

22. It is recommended that a program of periodic exercises be implemented with the objective of evaluating the unique organizational requirements brought out in this study, and to provide training to the government personnel involved. Command and communications exercises will accomplish much of the purpose without the expense of field deployments.

In the week after the murders of the four members of the Mountbattan family and 18 British soldiers, the "Economist" summarized[33] its perception of the source and probable direction of terrorism.

> Escalating terrorism needs to be countered by the sort of united international action from which most politicians have hitherto run away . . . unrestricted police co-operation across frontiers against terrorism has become essential in the free world for two reasons.
>
> First, terrorism is annually growing much easier because more technological. Second, political ferocity round the world is now more often connected with half-romantic ethnic divisions than with the class divisions wrongly assumed to be paramount by so many political thinkers since Marx.

> . . . the really worrying conflicts have been between ethnic groups (widely defined as 'all the groups of a society characterized by a distinct sense of difference owing to culture and descent'). These conflicts have included: 1) black versus white in most free countries that were in any way attached in the eighteenth-century to slave empires; 2) religious--Catholic versus Presbyterian, or Islam versus the others--in the relatively few European countries (Ulster, Holland) and the many Asian countries where seventeenth-century or earlier religious wars have absurdly set some of the social patterns still existing to this day; 3) linguistic--francophone versus anglophone Canadian or Fleming versus Walloon--in cobbled-together nineteenth-century countries; and 4) most viciously, tribe versus tribe in many of the new countries which have been created in the twentieth century by nineteenth-century liberals who decided (except in even more disastrous Ireland and Palestine) that you can sensibly create, e pluribus unum, a unitary state.
>
> . . . absolute cooperation against terrorism between police forces and intelligence forces is soon going to be essential among all civilized countries . . . The alternative, as terrorists eventually turn nuclear, is going to be to see the world blown up.

Without necessarily endorsing the writer's assessment of the cause and cure of terrorism, escalation to nuclear violence may shortly be upon us.

REFERENCES

1. "Reorganization Plan Number 3 of 1978," June 19, 1978, and the President's forwarding letter to the Congress of the same date.
2. "Federal Response to the Consequences of Terrorism," Initial Planning Guidance, FPA, Sixth Draft, October 3, 1977.
3. "A Bill to Strengthen Federal Policies and Programs and International Cooperation to Combat International Terrorism," Hearings before the Committee on Governmental Affairs, U.S. Senate, 95th Congress, Second Session on S2236.
4. California Penal Code, Title II, Section 422.5.
5. "Combatting International Terrorism: The Role of Congress," P-5808, The Rand Corporation, Santa Monica, January 1977.
6. Private Communication.
7. "Domestic Terrorism," a report by the Domestic Terrorism Study Group, Emergency Preparedness Project, Center for Policy Research, National Governors' Association, Washington, D. C., December 1978.
8. The discussion in this section draws on a private discussion with Mr. Brian Jenkins at the RAND Corporation; his paper P-6373, "The Consequences of Nuclear Terrorism," August 1979, and on the presentations made at the International Senior Executive Seminar on Terrorism at Pasedena, California, 29 May-1 June 1979, sponsored by the California Specialized Training Institute, Camp San Luis Obispo, California.
9. Editorial by George F. Will, *The Washington Post*, August 12, 1979.
10. Information in this section was obtained in interviews with the following DOE people: Dr. Donald Kerr, Deputy Assistant Secretary for Defense Programs, Mr. Troy Wade, Deputy Manager, Nevada Operations Office, Mr. Jim McGruder, Nuclear Systems Division, Nevada Operations Office, Mr. E. Wayne Adams, Nuclear Systems Division, Nevada Operations Office.
11. "Assigning Emergency Preparedness Functions to the Energy Research and Development Administration and the Nuclear Regulatory Commission," Executive Order 11953, January 7, 1977.
12. Glasstone, Samuel and Philip J. Dolan, The Effects of Nuclear Weapons. 3rd Ed. U.S. Department of Energy and U.S. Department of Defense, 1977.
13. "DCPA Attack Environment Manual," CPG 2-1A1 through 1A9, Defense Civil Preparedness Agency, June 1973.
14. Part of a letter from Major General J. K. Bratton, Director of Military Applications, DOE addressed to Mr. Clifford E. McLain, Deputy Director, DCPA, dated 4 June 1979.
15. "Nuclear Weapons Effects Programs DNA-1 Description of CROM Module," Horizons Technology, Inc., San Diego, California, HTI-R-78-107, 3 November 1978.
16. "Terrorist Nuclear Threat Blast Calculation Report," J. C. Baker, L. E. Bailey, Jr., and J. L. Waddell, Systems, Science and Software report SSS-R-79-3920, February 1979.

17. "Assessment of the Economic Impact of Terrorism on Industry," Joseph A. Hasson, Systems, Science and Software report SSS-R-79-3996, March 1979.

18. "Analysis and Identification of Nationally Essential Industries," Abner Sachs and Jane Leavitt, Volume I - Theoretical Approach; Volume II - Methodology and Results. Institute for Defense Analysis, Volume I, March 1974; Volume II, September 1975.

19. Defense Civil Preparedness Agency publication, High Risk Areas, TR-82, April 1975.

20. "Industrial Hardening Classification: A Methodology for Simplifying the Evaluation of Hardening Costs," Volume I - Text and Appendix A; Volume II - Appendix B. Institute for Defense Analysis, October 1966, S-263, L. J. Bickley and Abner Sachs.

21. Private Communication, Dr. Robert Kupperman, Chief Scientist, Arms Control and Disarmament Agency, 16 October 1978.

22. "The United States Government Antiterrorism Program," Draft, May 1978, prepared by the Executive Committee for Combatting Terrorism for the Special Coordination Committee of the National Security Council.

23. Private Communication, October 16, 1978.

24. "Joint Federal Bureau of Investigation, Department of Energy and Department of Defense Agreement for Response to Improvised Nuclear Device Incidents," undated draft received March 1979.

25. "Federal Response Plan for Peacetime Nuclear Emergencies (Interim Guidance)," April 1977, Federal Preparedness Agency, General Services Administration, including separately bound Annex I - "Guidelines for Federal - State Relationships;" and Annex II - "An analysis of Legal Authorities in Support of the Federal Response Plan for Peacetime Nuclear Emergencies.

26. "1978 Emergency Preparedness Project - Final Report," a report by the Emergency Preparedness Project Staff, Center for Policy Research, National Governors' Association, Washington, D. C., December 1978.

27. The National Governors' Association Policy Position A-19, "Comprehensive State Emergency Management." Included as Appendix M in reference 26.

28. "Nuclear Blackmail or Nuclear Threat Emergency Response Plan for the State of California," December 1976, sponsored by the Office of Emergency Services.

29. Private Communication. Mr. Brittell is currently a consultant to the Nuclear Regulatory Commission in security aspects of the Pennsylvania Nuclear fuel cycle centers.

30. Background chronological data of events at TMI were obtained from a series of staff articles in *The Washington Post* in the period April 8-11, 1979.

31. Private Communication from Mr. Sam Wilson, DCPA, who summarized that agency's involvement in TMI.

32. Harrisburg Report No. 1, "Civil Preparedness Activities in the Harrisburg Crisis," an undated initial report prepared by the DCPA staff.

33. "National Emergency Assistance Programs," a report by the National Emergency Assistance Programs Project Group, Center for Policy Research, National Governors' Association, Washington, D. C.

34. "The Economist," September 1, 1979.

BIBLIOGRAPHY

"Analysis and Identification of Nationally Essential Industries," Abner Sachs and Jane Leavitt, Volume I - Theoretical Approach; Volume II - Methodology and Results. Institute for Defense Analysis, Volume I, March 1974; Volume II - September 1975.

This report reviews previous research by DCPA and the IEB in determining criteria for location of essential or critical industries vital to the operation of the U.S. economy. A comparison and evaluation of these criteria is made. Suggestions for future research on these fields are given.

The Effects of Nuclear Weapons. Samuel Glasstone and Philip J. Dolan, 3rd edition, U.S. Department of Energy and U.S. Department of Defense, 1977.

This is the most definitive compendium of nuclear weapon effects available in unclassified form. It has evolved through a series of revisions from the original version published in 1950. An introductory chapter discussing the general principle of nuclear explosions is followed by chapters dedicated to air, ground, and water blast phenomenology; air and subsurface blast effects; thermal radiation; initial nuclear radiation; residual nuclear radiation and fallout; high-altitude radio and radar effects; electromagnetic pulse; and biological effects. Most chapters are divided into two parts - the first rather less technical, and the second which presents more of the mathematical details.

"DCPA Attack Environment Manual," issued in nine separately bound chapters, CPG 2-1A1 through CPG 2-1A9, June 1973, with the exception of CPG 2-1A4 (June 1977).

This is a practical guide on nuclear weapons effects and civil defense response actions directed towards operational readiness at the local levels for those having no previous technical training. The initial chapter, which uses an illustrative 5-MT weapon attack on a large city, is followed by more detailed chapters on blast, fire, electromagnetic pulse, initial nuclear radiation and fallout. The last chapters are devoted to shelter operations and a broader range of emergency operational planning. The whole manual is organized in a form appropriate for a briefing or lecture, along with illustrative graphic material.

"Assigning Emergency Preparedness Functions to the Energy Research and Development Administration and Nuclear Regulatory Commission," Executive Order 11953, January 7, 1977.

This order charges both ERDA and NRC to prepare emergency plans and develop preparedness programs for managing their responsibilities in emergency situations including nuclear attack. It specifically directs ERDA to participate in search and recovery operations for nuclear materials and weapons, and to maintain liasion with NRC and states during periods of national emergency. NRC is directed to develop plans for optionally shutting down or continuing operations of reactors, and to develop contingency plans with ERDA concerning theft of radioactive waste materials.

"High Risk Areas," TR-82, April 1975, issued by the Defense Civil Preparedness Agency.

Based on assumed potential nuclear targets in the U.S. of military bases, industrial facilities, and population centers of over 50,000, a hypothetical Soviet attack is developed in both air burst and surface burst alternatives. State maps, including county borders, are shaded by those areas with a 50% probability of being subject to 2 psi or greater, or fallout of 10,000 roentgen or greater. In addition to the map data, tabular data are presented of the population, and the population at risk, on a county-by-county basis throughout the U.S.

"Joint Federal Bureau of Investigation, Department of Energy, and Department of Defense Agreement for Response to Improvised Nuclear Device Incidents," a draft document received March 1979, as yet unsigned by any of the agencies involved, and intended to amplify the following separate MOU's currently in effect:

1. DOD/DOE agreement of 1 March 1977
2. DOE/FBI MOU of June 1976
3. Attorney General's letter to the Secretary of Defense, November 10, 1972

This MOU establishes the FBI as having the lead management responsibility during a nuclear terrorist event, with the DOE providing technical support services in threat interpretation and nuclear device search operations, and the DOD providing explosive ordnance disposal experts. Procedures for carrying out the various phases of an operation are outlined, with some uncertainty evident in the last, or "post incident operations" phase. Although it is stated that "the FBI . . . will have primary responsibility for post-incident operations," these are probably intended to be restricted to its traditional investigative and law enforcement role.

"The United States Government Antiterrorism Program," prepared by the Executive Committee for Combatting Terrorism for the Special Coordinating Committee of the National Security Council, May 1978.

This brief report summarizes the various unclassified and public antiterrorism policies and plans of the United States Government (USG) as articulated by the agencies involved. Although there is no formally approved USG policy on terrorism, the informal State Department guidelines are presented for managing international terrorism. The interrelationships and responsibilities of the Special Coordinating Committee of the NSC, the Executive Committee for Combatting Terrorism, the Working Group to Combat Terrorism, and several involved agencies are presented. After a discussion of the State and Justice Departments' response options in incidents, an outline is presented for summarizing the status of protection and security arrangements in several sectors of the government, business, and supporting infrastructure. It appears that this report has not as yet been accepted by the other responsible USG agencies as a vehicle for developing a coherent USG terrorist response plan.

"Evaluation of Industrial Systems Interrelationships and Vulnerability to Nuclear Attack," J. E. Minor, A. J. Pryor, G. E. Commerford, and R. C. DeHart, Southwest Research Institute, San Antonio, Texas 78228, November 1969.

The report advances a general methodology for defining, analyzing, and evaluating manufacturing systems, including an evaluation of the vulnerability of these systems to nuclear attack. The general methodology is exercised by implementing four major steps and using the Detroit Standard Metropolitan Statistical Area as a study model: (1) inventory and network definition of systems, (2) characterization of manufacturing systems and systems interrelationships (3) identification of essential industries, and (4) vulnerability analysis and evaluation. Comprehensive data and information describing the manufacturing systems and supporting services systems in Detroit are presented in a form and format readily adaptable to incorporation in the Systems Evaluation Division, Geographical Nodal Network. Implementation of the methodology in a step by step, illustrative procedure reveals problems in areas concerned with analysis and evaluation processes, as well as in areas concerned with manufacturing systems responses in the post-attack period. A summary which includes systems evaluators' comments regarding the manufacturing system description, the methodology, and the vulnerability of the system, concludes the report.

"1978 Emergency Preparedness Project," Final Report, the Center for Policy Research of the National Governors' Association, Washington, D. C., December 31, 1978.

This research study concerning the critical problems of state preparedness for attack and natural disasters used data assembled through a survey of 57 states, commonwealths, and territories concerning events, state organizations, and state-Federal relationships that affect disaster programs. Subsequent field surveys developed historical data on thirty natural and man-made disasters in eight states, concentrating on gubernatorial and agency involvement in the several phases of each disaster. Next, Federal agencies were surveyed not only as to their involvement with the states in these particular thirty disaster incidents, but also as to their general functions.

From these survey data a concept of Comprehensive Emergency Management is developed which places the governor in direct control of a formalized state structure headed by a Comprehensive Emergency Manager who uses all appropriate state assets to monitor preparedness, develop information, and implement actions in all disaster phases. The numerous recommendations developed are in the categories of policies, needed legislation, organizational relationships, state comprehensive emergency management, and mitigation.

"Comprehensive Emergency Management - A Governor's Guide," a report by the National Governors' Association Center for Policy Research, Washington, D. C., March 1979.

This guide highlights the findings of the NGA Emergency Preparedness Projects study, recommends an approach to comprehensive state emergency management, and offers pertinent management advice and tools based on hard-won experience in a variety of states.

One section covers the evolution and current organizational status of Federal emergency programs as well as the generally disorganized and incomplete status of state programs. The case is made for the development of a comprehensive emergency structure in each state that would place the governor in timely and effective control of state assets and provide effective interaction with involved Federal and local authorities.

"Federal Emergency Authorities - Abstracts," a report by the Emergency Preparedness Project, Center for Policy Research, National Governors' Association, Washington, D. C., December, 1978.

This handbook outlines, abstracts, and analyzes the authorities for the Federal and national organization programs included in the National Emergency Assistance Guidelines handbook published by the National Governors' Association in December 1978.

This publication includes pertinent sections of emergency-related Federal statutes, regulations, executive orders, and inter-agency agreements. They are grouped by chapter under subject matter categories with sub-headings. The Table of Contents includes the sub-headings for each chapter. Inclusions are related to mitigation, preparedness, response, and recovery aspects of emergencies.

Each chapter is preceded by an introduction which identifies the authorities included, a discussion of their evolution and present status, and relevant legislation proposed during the 95th Congress of 1977-1978. The authorities included are in three categories, with citations as follows:

- Statutory Authorities - most sectional citations are to the public law, as amended, with a parallel citation to the United States Code noted in brackets.
- Regulations - citation is to the Code of Federal Regulations. Because the Code is constantly updated, amendments to the regulations are cited to the Federal Register.
- Executive Orders - citation is to the Federal Register.

The Consequences of Nuclear Terrorism. by Brian Michael Jenkins, the Rand Corporation, P-6373, August 1979.

It is assumed that by 1990, in a world of continued political fragmentation driven by increasing ethnic and economic pressures, nuclear proliferation by States will have accelerated and, in combination with a general increase in terrorist violence, will lead to a credible likelihood of nuclear terrorism. It is also assumed that at least several terrorist groups have the funding and organizational and technical skills to obtain the required nuclear material and fabricate and detonate a clandestine device. Its use is assumed to be in a city, with a sub-kiloton yield producing tens of thousands of casualities.

The consequences of such an act are hypothesized to be increased security precautions to protect nuclear facilities, an erosion of individual rights perhaps up to imposition of martial law, a rapid increase in subsequent nuclear terrorism-particularly hoaxes, an increase in international cooperation amongst like-minded nations, a rapid increase in proliferation amongst third-world or otherwise disaffected nations, an increase in limited military attacks on the territory of other nations to prevent or alleviate terrorist acts, an increase in anti-nuclear energy and general disarmament sentiment in the affected nation, a possible increase in religious fanaticism, possible unilateral preemptive military action against nations providing a base for such groups, and new study of the possibility that what appears to be the product of a subnational terrorist group is in reality a paramilitary nuclear attack by an enemy state.

"Domestic Terrorism," prepared under the Emergency Preparedness Project, Center for Policy Research, National Governors' Association, Washington, D.C., December 1978.

This report contains a review of definitions of terrorism, a discussion of international and domestic trends in terrorism, and identification of terrorist groups which, according to newspaper reports, are active in the United States. The report summarizes Governors' state legislative authorities related to terrorism management, and abstracts Federal legislation related to terrorism. The report also identifies sources of assistance provided by Federal agencies. A check list which Governors may wish to use in reviewing their terrorism management prerogatives is included in the Executive Summary.

"National Emergency Assistance Programs - A Governors' Guide," prepared by the Emergency Preparedness Project, Center for Policy Research, National Governors' Association, Washington, D.C., December 1978.

This handbook is a catalog of 220 national emergency-related programs of the Federal government and private national organizations potentially available to states under appropriate circumstances. It is structured by Federal organization and cross indexed by subject. Each program is presented in a standard format: name of program, purpose of program, organization providing (substructured down to the name of the administrative unit), assistance (type offered - under sixteen standard categories), eligibility (organizations which may apply, conditions and beneficiaries), application procedure (who should be contacted, required forms), management considerations (legal status of authorization, matching fund requirements, other special requirements), funding, (level and status - whether proposed, authorized, appropriated, allocated - for FY 77, 78, 79), authorization (legal basis - generally by statute or public law number), information source (name and address of the local-level administrative office), and national office contact (name, address, and phone number of the source of information used).

"The New Generation: Moderation, Radicalism, and Terrorism" report on the Williamsburg Conference V, held in the spring of 1978, chaired by Congressman Clement Zablocki, sponsored by the Center for Strategic and International Studies of Georgetown University and reported in The Washington Quarterly, Autumn 1978, Volume 1, Number 4.

1. Second Thoughts on Terrorism by Walter Laqueur. A review of recent trends in terrorism, including ideology, sympathizers, individual national trends, the continuing discussion over a definition, and current attempts to systematize its characteristics and causes.
2. From Peron to Somoza - The New Terrorism, by Ernst Halperin. Reviews the evolution of South American rural guerilla warfare into urban terrorism having limited popular support. The center of Latin terrorism has now shifted to Central America, where the Cuban-sponsored Nicaraguan Sandinistas organization has evolved from a middle-class group of Marxist ideology to a pragmatic group with significant upper-class support having the specific objective of the overthrow of Somoza.
3. Terrorism in the Middle East. A New Phase? by Yonah Alexander. Recent PLO and PFLP operations indicate a continuing trend towards brutalized, mass violence, including reported planning for the use of biological, chemical, and nuclear instruments. Factionalism within the movement continues and deepens, while at the same time consolidation of an international network linking them with other terrorist groups is evident. PLO support by the USSR is discussed.

"Federal Response Plan for Peacetime Nuclear Emergencies (Interim Guidance)," April 1977 GSA/FPA published in three volumes, including the basic guidance documents and two annexes.

Policy and planning guidance is provided for the coordinated Federal response to four general categories of nuclear emergencies: minor, potentially serious, occurrence of a serious, and recovery and rehabilitation following a serious incident. While existent planning focuses on technical and emergency response, this plan provides the framework for the integration of subordinate plans for Federal assistance in immediate lifesaving actions and long-range recovery and rehabilitation measures. The concept of lead agencies called "operational response planning agencies" or ORPA's is developed, with other Federal departments designated as supporting agencies. The ORPA's for several types of emergencies under each of the four general categories are designated, as well as the responsibilities for each of the thirty support agencies outlined. Finally, each of the ORPA's are called upon to develop appropriate response plans, coordinate them with supporting agencies, and forward them to FPA to assure consistency and for eventual inclusion in the FRPPNE. The final product is to be used not only by Federal agencies, but most particularly by state and local authorities as a guide to the Federal ability to respond to their nuclear emergency needs.

Annex I "Guidelines for Federal-State Relationships" outlines illustrative state structural planning for response, noting that existent planning decreases as one goes to higher categories. Federal policies and capabilities are outlined, appropriate relationships for each category specified, and an illustrative state plan given.

Annex II "An Analysis of Legal Authorities in Support of the Federal Response Plan for Peacetime Nuclear Emergencies." This examination of the legal sources of authority for Federal action in support of nuclear emergencies concludes that ample authority exists for any of the four categories described in the FRPPNE.

Attributes of Potential Criminal Adversaries of U.S. Nuclear Programs. Rand, Santa Monica, California, February 1978 R-2225-SL. Peter deLeon, Brian Jenkins, Konrad Kellen, Joseph Krofcheck.

There is essentially no U.S. data base on which to draw of seisure of a nuclear installation resulting in release of radioactivity, illegal theft or detonation of a nuclear weapon, nor theft of nuclear materials subsequently used for blackmail or made into bombs. Lacking this, a study was made of several hundred typical cases of six classes of roughly analogous actions: task force crimes, terrorist assaults, commando raids, industrial sabatoge, symbolic bombings, and nuclear incidents. From these characteristics two composit adversaries were constructed: a "typical composit profile" and a "high-level composit," the latter representing the upper bounds of feasibility but one never achieved in all its characteristics. However, the reader is cautioned that there is no apparent reason such a high level of composit attributes could not be gathered, should the objective require it. Some suggestions are made as to an approach for designing defensive systems which demand that all the high-level composit characteristics be simultaneously achieved by an adversary to result in success.

Nuclear Blackmail or Nuclear Threat Emergency Response Plan for the State of California. December 1976, sponsored by the Office of Emergency Services, State of California.

This is a comprehensive plan which summarizes the responsibilities and outlines appropriate actions of Federal, state, and local organizations in a wide range of nuclear threats. A comprehensive set of authorities is listed and the response addressed in two phases: dealing with the threat and actions following the carrying out of the threat. Possible types of threats are identified and the resultant classes of hazards discussed. Response actions are under Federal (FBI) control, with state support coordinated through the Office of Emergency Services (OES). Protective actions are a mayoral (or other local authority) responsibility, with State (through OES) and Federal (through FPA) support. Types of protective actions which may be required, and assets required to support them, are outlined.

There is no indication that this document has obtained general concurrence at local, state, or Federal agency level, although it is used for operational guidance by the California OES.

Superviolence: The Civil Threat of Mass Destruction Weapons. Adcon Corporation, Santa Barbara, California, Advanced Concepts Research, B. J. Berkowitz, Principal Investigator; M. Frost, E. J. Hajic, H. Redisch, September 29, 1972.

The threat of the use of mass destruction weapons (MDW's) against U.S. domestic targets is addressed in the several broad aspects of the weapons themselves, the individuals who might be involved, the resources required to make MDW's, and the ways they might be used. A qualitative examination of political, sociological, psychological and criminal backgrounds lead to the conclusion that MDW's do not generally fit the requirements of terrorists so that any use would have to be by an exceptional person or small group, or that it would be in the form of a coercive threat only. The assessment of nuclear technological credibility leads to the conclusion that, although illicit weapon fabrication is both plausible and feasible, the probability that all of the necessary elements of skill, motivation, resources and opportunities will coalesce into a successful use is low. The use of bacteriological weapons is held more feasible. The issue of potential targets is not addressed. Although actual use is finally assessed as being so unlikely as not to warrant practical concern, coercive or sham threats are likely and control measures must be planned.

"A Pump Failure, a Claxon Alert, a Nuclear Crisis," The Washington Post in the (1979) April 8-11 issues inclusive, by Laurence Stern, Daniel J. Balz, Milton R. Benjamin, Paul Brinkley-Rogers, Warren Brown, Victor Cohn, Jane Freundel, Joel R. Garreau, Peter Milius, Thomas O'Toole, Bill Peterson, Walter Pincus, Wendy C. Ross, Martin Schram, Ward Sinclair, J. P. Smith, T. R. Reid, Bill Richards, Edward Walsh, and Hugh Craig.

This reporters' chronicle, which appeared in fourteen chapters, presents a chronological picture of the events surrounding the Three Mile Island nuclear accident. Although frequently anecdotal, it identifies most of the individuals and organizations involved and discusses their interactions, placing particular emphasis on the efforts of Federal, state and local authorities to prepare for a major evacuation. Implicit in the story

development are several general observations and conclusions: reactor regulatory and licensing rules need strengthening, the governor was essentially excluded from decisions of vital interest to him, Federal agency planning was generally inadequate, and public information policy was inadequately handled.

"Facing Tomorrow's Terrorist Incident Today," by Robert H. Kupperman for the Law Enforcement Assistance Administration, U.S. Department of Justice, October 1977.

The potential for increased levels of violence in terrorism, even without invoking chemical, biological, or nuclear weapons, requires an analysis of the whole sequence of such activity: the nature of terrorists, means of defense, policy choices in negotiations, and technical aids and organizational requirements in event management. The summary conclusion reached is the need for prudence and planning in combatting terrorism, with the development of a national incident crisis management system the most pressing need.

"Reorganization Plan No. 3 of 1978," submitted by the President to the Congress, June 19, 1978.

This plan consolidates emergency preparedness, mitigation and response activities into a newly created Federal Emergency Management Agency. Transfered to it were the authorities and functions of DCPA, FDAA, FPA, National Fire Prevention and Control Administration, Federal Insurance Administration, the Emergency Broadcast System, the Earthquake Hazards Reduction Program, dam safety, and coordination of preparedness and planning to reduce the consequences of major terrorist incidents. The policy established is that one official should supervise national response to civil emergencies, that civil defense requires the use of all emergency resources, that emergency responsibilities should be an extension of the regular missions of Federal agencies, and that hazard mitigation should be linked to emergency preparedness and response functions.

"Federal Response to the Consequences of Terrorism - Initial Planning Guidance," Federal Preparedness Agency, Sixth Draft, October 3, 1977.

After a brief review of the threat of terrorism, with primary emphasis on the emerging dimension of disruptive terrorism, and the requirements for incident management, the main focus is on consequence management, vulnerability analysis, and an assessment of current preparedness. Nine potential target systems are identified and a list of Federal agencies having primary and supporting responsibility proposed. It is suggested that each responsible agency make a vulnerability analysis of its assigned target system, model the consequences, assess adequacy of current plans, coordinate preparedness planning, and provide for tests and exercises. It was proposed that scenarios be developed for terrorist attack against eighteen specific targets as a means of making these assessments.

It does not appear that general agency concurrences was ever obtained.

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THE ROLE OF CIVIL PREPAREDNESS IN NUCLEAR TERRORISM MITIGATION PLANNING

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DCPA01-78-C-0328
Work Unit 2613D
89 pages

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